POOR LEGIBILITY

ONE OR MORE PAGES IN THIS DOCUMENT ARE DIFFICULT TO READ
DUE TO THE QUALITY OF THE ORIGINAL

FEDERAL FACILITY PA/SI REVIEW

Site: Utah Test and Training Range Site
Immediately SW of Wendover
Wendover, Nevada 89835

Site EPA ID Number: ~~NVD021173448~~ NV2 570 090 017

Submitted to: Jeff Inglis
Nevada Project Officer
EPA Region IX

Date: 22 May 1995

Through: Quint Aninao, Supervisor
Superfund Branch
Bureau of Corrective Acitons

Prepared by: Barbara H. Benoy
Site Assessment Branch
Bureau of Corrective Actions

PETER G. MORROS, Director

L.H. DODGION, *Administrator*

(702) 687-4670
TDD 687-4678

Administration
Mining Regulation and Reclamation
Water Pollution Control
Facsimile 687-5856

Address Reply to:
Capitol Complex
Carson City, NV 89710

STATE OF NEVADA
BOB MILLER
Governor

Waste Management
Corrective Actions
Federal Facilities
Facsimile 885-0868

Air Quality
Water Quality Planning
Facsimile 687-6396

Located at:
333 W. Nye Lane
Carson City, NV 89710

DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES

DIVISION OF ENVIRONMENTAL PROTECTION

Capitol Complex
Carson City, Nevada 89710

Memorandum

Date: 24 May 1995

To: Jeff Inglis, EPA Region IX

Through: Quint Aninao, NDEP QA

From: Barbara H. Benoy Barbara H Benoy

Subject: Completed Report

Attached is the following completed document:

PA ________ SI ________ Other X Federal Facility Review (FFR)

Site Name: Utah Test & Training Range (UTTR) Site

EPA ID: NVD021173448

City, County: West Wendover, NV

For EPA Use Only

Latitude: ________________ Longitude: ________________

EPA Further Action Determination: ________________

Lead Agency: ________________

Sign Off Date: ________________

Initials of Work Assignment Manager: ________________

Document Screening Coordinator: ________________

Chief, Site Evaluation and Grants Section: ________________

MEMORANDUM

FEDERAL FACILITY PA/SI REVIEW
Utah Test and Training Range Site

(EPA ID NO. ~~NVD021173448~~)
NV2 570 090 017

Prepared for:

U.S. Environmental Protection Agency
Region IX
75 Hawthorne Street
San Francisco, CA 94105

22 May 1995

Submitted To: Jeff Inglis
Nevada Project Officer
EPA Region IX
5/25/95
Date

Prepared By: Barbara H. Benoy
Barbara H. Benoy
Site Assessment Branch
Bureau of Corrective Actions
5/22/95
Date

Through:
Quint Ahinao, Supervisor
Superfund Branch
Bureau of Corrective Actions
5/24/95
Date

TABLE OF CONTENTS
Utah Test and Training Range Site
West Wendover, Nevada

1.0 INTRODUCTION 1
1.1 Apparent Problem 2

2.0 SITE DESCRIPTION 2
2.1 Location 2
2.2 Site Description 2
2.3 Operational History 5
2.4 Regulatory Involvement 6

3.0 INVESTIGATIVE EFFORTS/PREVIOUS ANALYTICAL DATA 7
3.1 Previous Sampling 7
3.2 Sampling 7
3.2.1 Soil sampling 9
3.2.2 Groundwater Samples 9
3.2.3 Field Screening/CPT Samples 13
3.2.4 Discussion of Sample Results. 13

4.0 HAZARD RANKING SYSTEM FACTORS 13
4.1 Sources of Contamination 13
4.2 Groundwater Pathway 16
4.2.1 Hydrogeological Setting. 16
4.2.2 Groundwater Targets. 16
4.2.3 Groundwater Pathway Conclusion. 16
4.3 Surface Water Pathway 16
4.4 Soil Exposure and Air Pathway 17

5.0 EMERGENCY RESPONSE CONSIDERATIONS 17

6.0 CURRENT CONDITION OF THE SITE 17

7.0 SUMMARY 18

FIGURES AND TABLES

Figure 1 Site Location Map 3
Figure 2 Site Record of Survey Map 4
Figure 3 Sampling Locations for Lab Analyses 8
Figure 4 Field Screening Locations 13

Table 1 Soil Sample Results 10
Table 2 Groundwater Sample Results 11
Table 3 Field Screening Results 14

LIST OF APPENDICES

Appendix A Contact Log and Reports
Appendix B Latitude/Longitude Calculation Worksheet
Appendix C HRS Scoring and Rationale

FEDERAL FACILITY
PRELIMINARY ASSESSMENT/SITE INSPECTION REVIEW

FACILITY: Utah Test and Training Range Site
Immediately SW of Wendover
Wendover, Nevada 89835

EPA ID#: NVD~~021~~173448 NV2 570 090 017

DATE: 22 May 1995

PREPARED BY: Barbara H. Benoy

SUBMITTED TO: Jeffrey Inglis, Nevada Project Officer
EPA Region IX

1.0 INTRODUCTION

The U.S. Environmental Protection Agency (EPA), Region IX, under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986 (SARA)[1] has tasked the Nevada Division of Environmental Protection (NDEP) to conduct a Federal Facility Review (FFR) of the Utah Test and Training Range (UTTR) site in West Wendover, Elko County, Nevada.

The UTTR facility was identified as a potential hazardous waste site and entered into the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) in June of 1985.[2] NDEP has been unable to ascertain when the site was listed on the Federal Facilities Hazardous Waste Compliance Docket. Inquiries have been made to EPA Region's 8 and 9, to EPA Headquarters, and the Remedial Project Manager assigned to the site by the Air Force. A draft Preliminary Assessment/Site Inspection (PA/SI) Report was performed for the Department of the Air Force by Radian Corporation in December 1993.[3] A finalized PA/SI report was received by NDEP in March of 1995.[4]

The purpose of the PA/SI is to review existing information on the site and its environs to assess the threat(s), if any, posed to public health, welfare, or the environment and to determine if further investigation under CERCLA/SARA is warranted. This report is in response to EPA's request that NDEP evaluate the site using EPA's Hazard Ranking System (HRS) criteria.

The HRS assesses the relative threat associated with potential releases of hazardous substances from a site and is the method of determining a site's placement on EPA's National Priorities List (NPL). The NPL identifies sites at which EPA may conduct remedial response actions. This report is the result of NDEP's evaluation of the submitted data.

1.1 Apparent Problem

The UTTR facility is defined here as all areas outside the Wendover Air Force Auxiliary Field (AFAF) where bombing, gunnery target practice, or the disposal of live or potentially live ordnance has occurred within the Nevada state boundaries.[5] Hazardous substances on site may have been released into the environment through the groundwater pathway. The area of concern predominantly includes a landfill located within Nevada. An area directly south of the landfill, known as the Ordance Area, was initially included for this FFR.

The landfill allegedly received spent solvents, plating mill wastes, fuels and miscellaneous construction rubble. The contaminants of potential concern include metals, asbestos, volatile organic compounds (VOCs) and petroleum hydrocarbons. Groundwater sampling revealed low level detections of VOCs in the landfill area.[6] The Ordance area south of the landfill was not sampled.

2.0 SITE DESCRIPTION

2.1 Location

The overall UTTR facility includes a vast area of Utah and Nevada, totalling 3.5 million acres. Wendover AFAF is located east of the Utah/Nevada border, just south of the City of Wendover, Utah, (**Figure 1**). Wendover, Utah is located approximately 130 miles west of Salt Lake City, Utah and 110 miles east of Elko, Nevada. The geographical coordinates of the landfill are 42° 31′ 15.33" N latitude, 114° 3′ 30.17" W longitude (Township 33 N, Range 70 E, Portions of Sections 16, 20, 21, 28, 29, Mount Diablo Baseline and Meridian, Wendover, Nev.-Utah, 7.5-minute quadrangle, 1972).

The area of investigation for this FFR is limited to land areas within the state of Nevada. Air space and land areas within Utah are beyond the scope of this report. Information provided on areas within the State of Utah are for information purposes only. EPA Region 8 and the US Air Force are the lead agencies. The PA/SI report was generated by Radian Corporation and includes the areas known as the Wendover AFB and the UTTR.

2.2 Site Description

Wendover Air Force Base (AFB) and the UTTR were established during an Air Force expansion program. Together Wendover AFB and UTTR encompass 3.5 million acres. The Nevada portion of the Wendover AFAF covers approximately 1357.67 acres of land, according to a land survey included in an Environmental Baseline Study conducted by Applied Ecological Services, Inc., for the town of West Wendover.[7] The approximate limits of the landfill area are indicated on **Figure 2**. The acreage does not include the Ordance area to the south of the landfill.

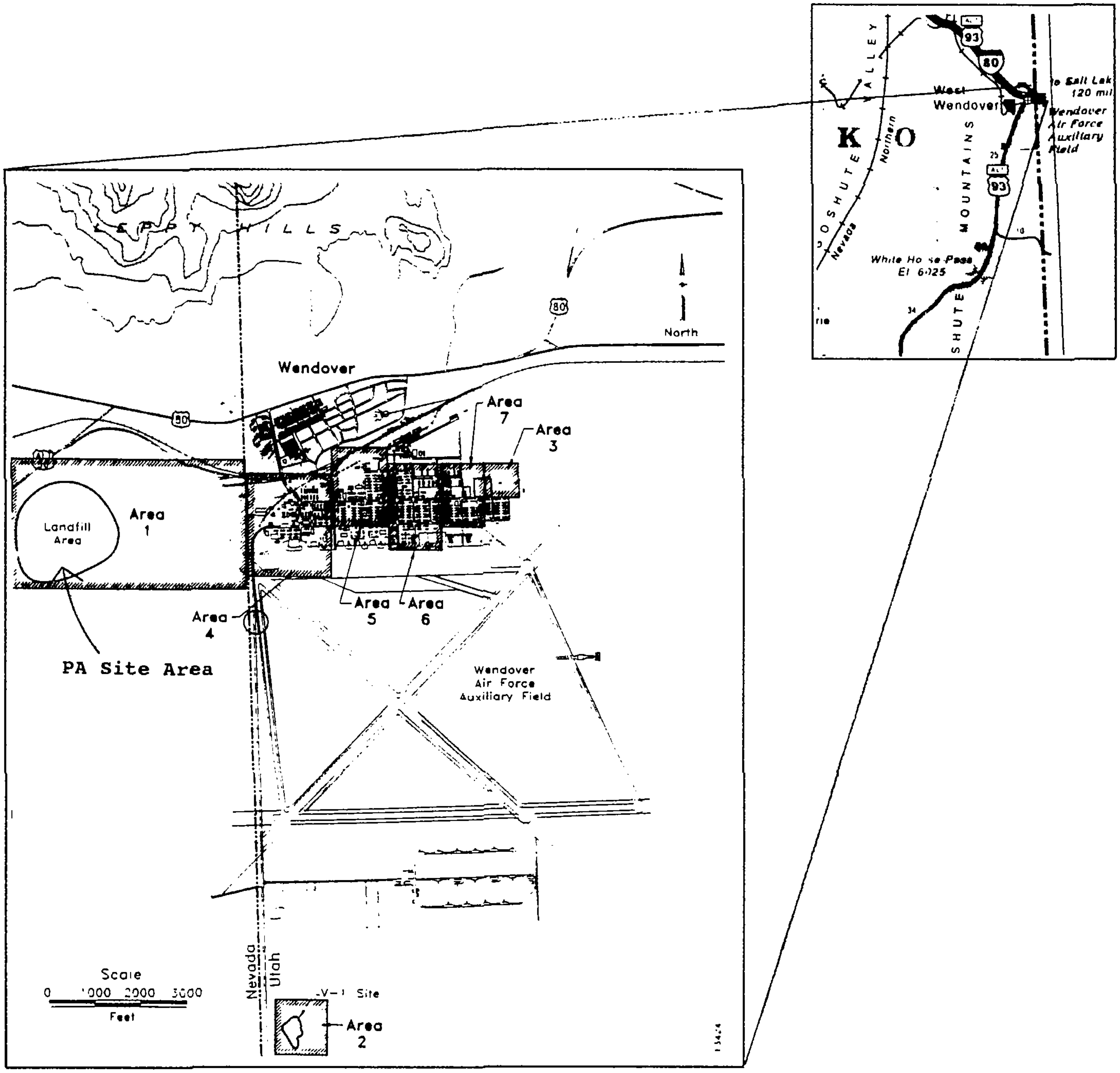


Figure 1 - Site Location Map
Utah Test & Training Range
Wendover, Nevada, Elko County

Source: Radian Corp., May 15, 1993. Work Plan for Preliminary Assessment/Site Investigation for Wendover/UTTR, Wendover, Nevada

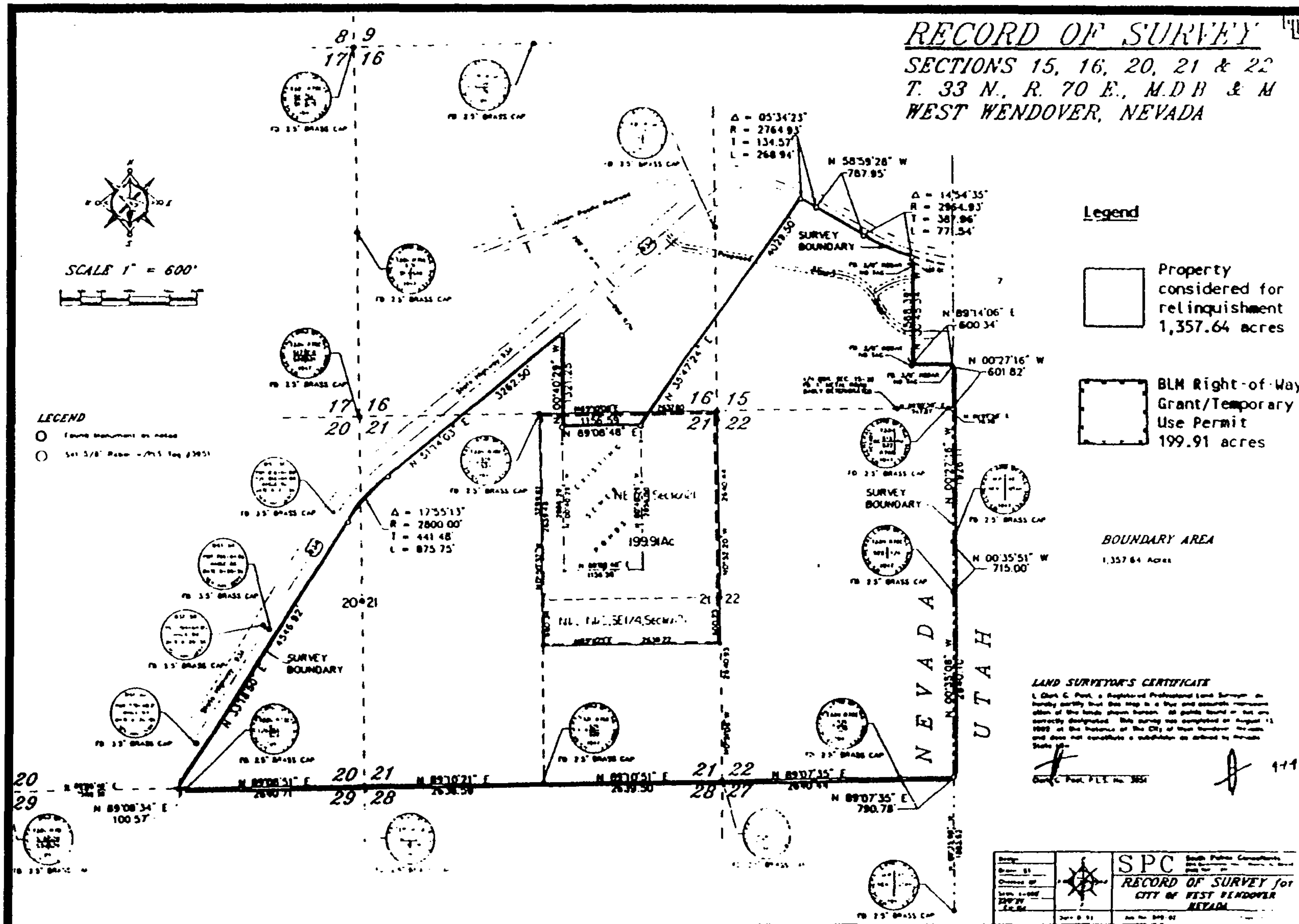


Figure 2 - Site Record of Survey Map
Utah Test & Training Range
West Wendover, Nevada, Elko County

Source: Environmental Baseline Survey, Air Industrial Park and Compost Facility for Sewage Sludge and Sewage and Municipal Solid Waste, 1,.357 Acres Within the Wendover Air Force Auxiliary Field, Elko County, Nevada, Applied Ecological Services, Inc., November 1994.

The site is bordered to the north by undeveloped land, Interstate 80 and a new paved road, to the south by undeveloped land, the east by undeveloped land and the Utah state border, and the west by Alternate Highway 50, (also designated as Alternate Route 93). The site has no permanent population.

Identification of potential sensitive species, plant and animal, that may exist in the site area was conducted. Two animal species were identified; no plant species were identified. The Pale Townsend's Big-eared Bat (*Plecotus townsendii*) is listed as a federally listed candidate, category 2 and the Red Fox (*Vulpes vulpes*) which is listed as a protected species of the State of Nevada.[8]

The region has an arid climate with low annual precipitation, low relative humidity, and high evapotranspiration rates. The mean annual precipitation recorded during the period 1961 to 1990 was 5.47 inches.[9] Temperature range can be substantial, varying from below 0° F in winter to above 100° F in summer. Winds are predominantly from the northwest or southeast, with speeds averaging 5 knots.[10] The two-year, 24-hour precipitation is estimated at one 1 inch.[11] Humidity ranges from approximately 24% in July to 69% in December.[12]

2.3 Operational History

The UTTR has been used continuously for bombing and gunnery practice for military practice since 1940. The land is owned by the Department of Defense (DOD). Prior to 1940, the land occupied by the UTTR accommodated sparse cattle and sheep herding activities. The vast majority of land surrounding the UTTR is managed by the Department of the Interior (Bureau of Land Management) as public lands and continues to be used for sparse cattle and sheep herding.[13]

During World War II, the Wendover AFB and the UTTR were used to train heavy bombardment groups. All necessary operational support facilities were constructed at the Base. Some of the past support facilities were identified during the PA/SI as potential sources of contamination. For Nevada, these areas are specifically limited to that area west of Wendover, Utah and includes the landfill and an area directly south of the landfill.

In the spring of 1945 base activity shifted to the development of weapons which included the testing and development of various types of missiles.

In December 1960, the Base was on inactive caretaker status, managed by Hill Air Force Base during a brief period and then reactivated in July 1961 as the Wendover Air Force Auxiliary Field. Portions of the Base were turned over to the town of Wendover in 1977.

Within the portion of the facility located in Utah are 110 remaining military-built structures. These structures vary from structurally sound to very deteriorated. About 30 of the buildings are currently in use. Three hangars are currently used for private aircraft storage. The primary use of the land by the military is for a radar tracking and search facility.

The landfill, located in Nevada, was used jointly by the military, the town of Wendover, and Elko County, Nevada, between the years of 1940 to 1975. Operation of the landfill was turned over to the town and Elko County in 1977. This use continued until about 1982, when another landfill was established in a different location. DOD retains ownership of the land occupied by the former landfill.

In 1981 approximately 318.98 acres of the Air Force Auxilliary Field was obtained from BLM by the Elko County Commissioners. A sewer treament plant and lagoon system was subsequently installed for servicing the City of Wendover, Nevada. BLM reclaimed 118.98 acres in 1989 under a Right-of-Way Grant/Temporary Use Permit. The plant is operated by the City of West Wendover.

The city has proposed a municipal solid waste and sewage sludge compost facility to upgrade the current treatment system. The status of this proposal is not known.

The city of West Wendover, Nevada, is also reportedly pursuing plans to develop a 1400-acre airport industrial park with its own airport taxi ways, rail spurs, and highway access. The 1400 acres would be obtained from within and around the landfill area. Custodianship of the land is currently held by Hill Air Force Base and the Bureau of Land Management. The proposed industrial park would be located immediately west of the current airport.

Figure 2 provides a Record of Survey map of the site area.

2.4 Regulatory Involvement

EPA Region 8 and the US Air Force are involved in characterization and investigation activities for the entire area considered the Wendover Air Force Auxilliary Field and Hill Air Force Range. The NDEP Federal Facilities Branch, has been an active partner with this effort regarding the Nevada portion. The NDEP Superfund Branch has current involvement to meet the US EPA criteria for Region 9 to meet the requirements of a Federal Facility Review on the site. The facility is not listed in the Nevada portion of the Resource Conservation and Recovery Act (RCRA) database (RCRIS).[14] It is not currently known if the site is listed under the RCRIS system in the State of Utah.

The Superfund Amendments and Reauthorization Act of 1986, Section 120, explicitly states that Federal facilities are required to comply with all guidelines, regulations, rules and applicable criteria for preliminary assessment, site investigation, National

Priorities listing and remedial actions.

Representatives of both the County of Elko and the City of West Wendover, Nevada have participated in meetings with the USAF and USEPA in activities regarding the landfill. The City of West Wendover has also generated an Environmental Baseline Survey specifically on the area of concern for this FFR report.

3.0 INVESTIGATIVE EFFORTS/PREVIOUS ANALYTICAL DATA

A Preliminary Assessment/Site Investigation (PA/SI) was conducted by Radian Corporation on behalf of the US Air Force. The final PA/SI Report was received by NDEP in March 1995. The scope of this Federal Facility Review, (FFR) includes sampling data from that PA/SI report. Additional information was obtained from other data sources and is referenced within the report.

3.1 Previous Sampling

No previous sampling prior to the PA/SI report specifically in the landfill area is known to have been conducted.

3.2 Sampling

Samples were collected to characterize the site under the Hazard Ranking System (HRS) developed for EPA. Sites were scored individually to represent the various areas and activities of UTTR and Hill AFB for the Comprehensive PA/SI report. This discussion applies only that portion of the site located within Nevada.

Much of the field characterization was done by cone penetrating test methods or CPT. Twenty locations were selected to delineate potential contamination in the landfill area. Sixteen of those locations were used in a field screening of groundwater samples; three were used for screening of soil gas samples. Eight soil samples were collected for laboratory analyses based on the results of the CPT and screening results. Four monitoring wells were installed, samples collected and subjected to laboratory analyses.

The Apron Area is located mostly within Utah, though some of the samples collected to characterize the Apron Area were obtained from stations in Nevada. No significant levels were observed in the Nevada section of the Apron Area. No samples were collected from the Ordnance Disposal Area since visual inspection indicated no further investigation was necessary. Representatives from Nevada Division of Environmental Protection, Bureau of Federal Facilities, were in agreement with this assessment. **Figure 3** provides the sampling locations of samples sent for laboratory analyses. The smaller area identified within the landfill is an area where plating wastes may have been disposed.

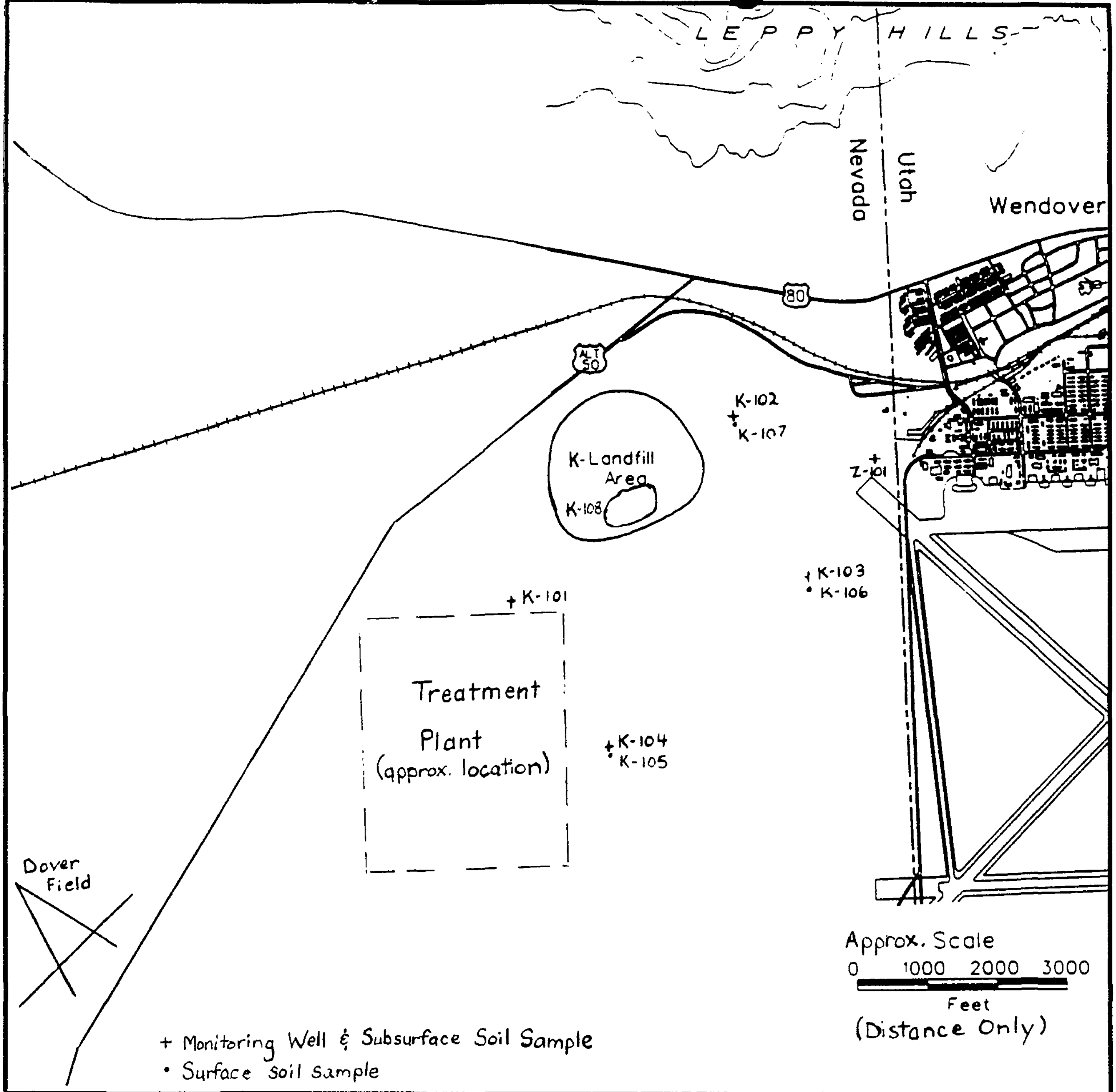


Figure 3 - Sampling Locations Collected for Laboratory Analyses
Utah Test & Training Range
West Wendover, Nevada, Elko County

Source: Composite Map generated from Figure 2-1 and Plate 2, Preliminary Assessment Site Investigation for Wendover AFAF & HAFB, Vol. 1, Radian Corp., Dec. 1994.

3.2.1 Soil sampling

Soil sampling was conducted to determine whether residual contamination exists in soils as a result of past activities at Hill AFB. Resulting concentrations were considered to determine if potential source areas existed which might continue to release contamination. **Table 1** provides the results of the laboratory analyses.

Soil samples were collected from above the water table during the drilling from all boreholes. Surface soil samples were also collected, though the surface depth of sample collection was not defined. All soil samples were analyzed for full scan inorganic parameters, referred to as TCL/TAL analytes.

The landfill area is referred to as area K within the PA/SI report. Eight soil samples and four groundwater samples were sent for lab analyses. Soil gas field analysis on three location was done to help delineate the extent of subsurface contamination. Samples are designated by a code such as **K-004**. Results of analytical runs on samples are provided in **Tables 1** and **2**.

Results of the soil sample analyses revealed no concentrations of organic contaminants exceeding RCRA Subpart S Action Levels. These levels were used for comparison basis only by Radian Corporation. Inorganic analyses detected arsenic and beryllium in quantities that did exceed those levels. These sample detections are presented in **Table 2**.

Area K, or the landfill, was categorized as having "intermediate" volatile organic compound concentrations, (VOCs). Intermediate was defined (as <1 and >0.09 ppm) by the PA/SI report. Area Z, the Apron Area, was considered as having the highest levels of VOCs, but these high concentrations did not extend into Nevada.

The report described the beryllium levels in Area K as "relatively high concentrations" (>0.3 mg/kg). The maximum concentration of beryllium in soil was 0.429 mg/kg. **Table 2** provides soil concentrations.

3.2.2 Groundwater Samples

Groundwater sampling was conducted to determine potential contamination which had resulted from past releases of various activities of Hill AFB and/or the town of Wendover represented by the waste materials deposited into the landfill.

Groundwater contamination has been determined in the vicinity of the landfill. All samples were collected from outside the actual landfill boundary and determined contamination which may be leaching from the fill into the aquifer. No organic compounds were detected above maximum contaminant levels (MCLs). Results of groundwater analysis are shown in **Table 2**. Thallium exceeded the

Table 1 - Results of Soil Samples
Distribution of Inorganic Contaminants in Soil (mg/kg)
Exceeding RCRA Subpart S Action Levels

Sample Code	**Arsenic (SW7060)**	**Beryllium (SW6010)**
K-101-312 [c]	4.5	0.248 B
K-102-314 [c]	4.36	0.296 B
K-102-314-FD [c]	5.78	0.283 B
K-103-316 [c]	5.91	0.204 B
K-104-318 [c]	6.75	0.169 B
K-105-354 [d]	3.44	0.317 B
K-106-355 [d]	1.46	0.429
K-107-356 [d]	4.24	--
K-107-356-FD [d]	5.52	--
K-108-357 [d]	7.56	--

c Subsurface soil sample collected from above the water table at a depth of <9'bgs.
d Surface soil sample.
B Analyte detected in method blank.

Table 2 - Results of Groundwater Samples
Landfill Area

Compound	K-101-407	K-102-408	K-103-409	K-104-410	Z-101-417
Organics (ug/l) SW-8240, SW-8015 MP					
1,2-dichloroethane	2.02	2.96	1.11/(3.19)[a]	2.42	--
acetone	10.3 B	8.82 B	8.39/(8.98)B	11.0 B	--
methyl ethyl ketone	--	--	--	3.52 B	--
toluene	0.326 B	0.794 B	0.425/(0.402)	0.205 B	0.492
xylene	--	0.551 B	--/(0.241)	0.232 B	--
Pesticides SW-8080					
alpha-BHC	--	--	--	--	0.0028
Inorganics (mg/l) SW-6010					
antimony	--	--	--	--	0.0184
thallium (MG/L)	--	--	0.0125 J	0.00549 J	0.0365

a Field duplicate blank results provide in parentheses.
J Estimated value.
B Detected in analyte blank
-- Non-detect

MCL in two of the groundwater samples collected in area K. The analytical results of thallium may be biased high based on the presence of thallium in the method analytical blank. Groundwater obtained from the monitoring well located in the Apron area (Z-101-417, showed levels of organic and inorganic contamination. The landfill may not be the source of this contamination; contaminant migration may have originated in Utah.

3.2.3 Field Screening/CPT Samples

Field screening samples were collected using CPT and provide a lower quality of data than laboratory analyses. Results of the field screening were utilized during selection of sample locations submitted for lab analyses. Locations of the screening samples are shown on **Figure 4**. Locations are approximate. Results of the field analyses are shown on **Table 3**. These data are presented last in the report since data quality generally lacks analytical confirmation.

3.2.4 Discussion of Sample Results.

Samplin efforts documented the presence of low level contamination in groundwater, surface and subsurface soils. Filed analysis of soil gas and groundwater samples were used to determine the locations of samples subjected to laboratory analyses. Some filed screening locations were in closer proximity to the landfill than those samples collected for further analyses.

4.0 HAZARD RANKING SYSTEM FACTORS

4.1 Sources of Contamination

The landfill area had received wastes including from various operations. There is only a qualitative listing of substances which were placed in the landfill. This listing was based on interviews conducted with individuals who had worked at the base during active years and are based solely on the individuals' memory. Copies of the interviews are included in the PA/SI report, Appendix B. The list of substances may be incomplete. No documentation has been located to substantiate any waste quantities of materials placed in the landfill, though many of the materials identified in the interviews are considered hazardous. Groundwater sampling at this site showed very little impact on the groundwater from the landfill. However, there may be very little likelihood for human exposure from any potential sources at or in the landfill. Evaluation of the landfill as a potential source was conducted for each pathway. The groundwater pathway was determined to be the most significant of all pathways, though none of the pathways represent an exposure hazard.

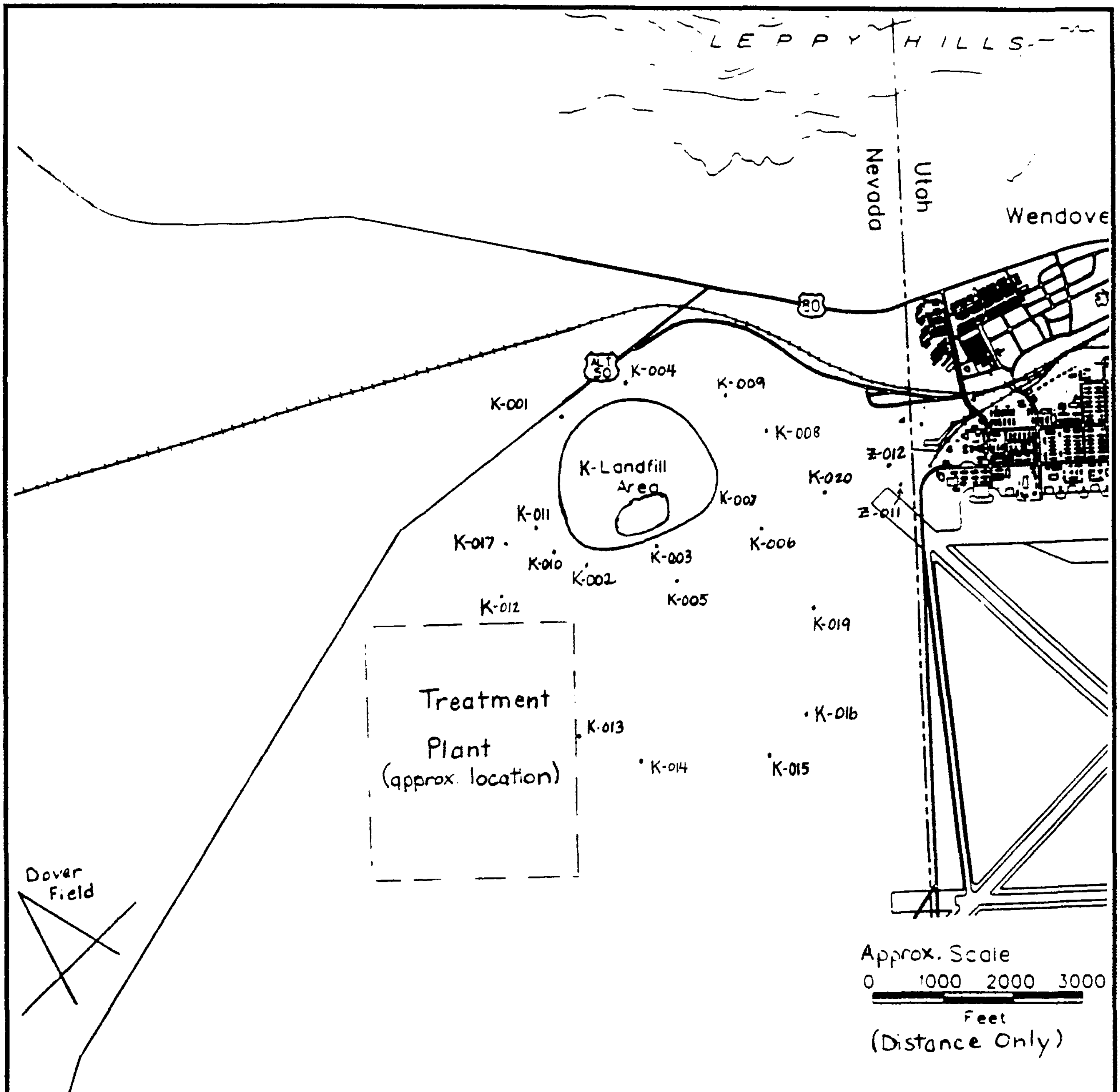


Figure 4 - Field Screening Locations
Utah Test & Training Range
West Wendover, Nevada, Elko County

Source: Composite Map generated from Figure 2-1 and Plate 2, Preliminary Assessment Site Investigation for Wendover AFAF & HAFB, Vol. 1, Radian Corp., Dec. 1994.

Table 3 - Results of Field Screening Analysis
Cone Penetrating Tests

		Detected Volatile Organics			
	Sample type	acetone	chloroform	toluene	methylene chloride
K-02-127	groundwater	0.05	--	--	0.05
K-03-166	groundwater	0.5	--	--	0.01
K-04-000	soil gas	--	--	0.057	--
K-05-160	groundwater	--	--	--	--
K-06-161	groundwater	--	--	--	--
K-07-167	groundwater	--	--	--	--
K-08-162	groundwater	--	--	--	--
K-09-007	soil gas	--	--	--	--
K-10-168	groundwater	--	--	--	--
K-11-008	soil gas	--	--	--	--
K-12-186	groundwater	0.2	--	--	--
K-12-187	groundwater	0.4	--	0.01	--
K-13-188	groundwater	0.3	--	--	0.07
K-13-189	groundwater	0.3	--	--	--
K-14-190	groundwater	0.5	--	--	--
K-15-191	groundwater	0.2	--	--	--
K-16-192	groundwater	0.10	--	--	--
K-17-206	groundwater	0.10	--	--	--
K-18-207	groundwater	--	--	--	--
K-18-208	groundwater	--	--	--	--
K-19-209	groundwater	--	--	--	0.7
K-20-210	groundwater	--	--	--	0.04
Z-11-214	groundwater	--	--	--	--
Z-12-215	groundwater	--	0.5	--	--

4.2 Groundwater Pathway

4.2.1 Hydrogeological Setting.

The water table at the site is encountered at approximately 35 feet below ground surface. According to the PA/SI Report, groundwater occurs within the basin fill in both shallow unconfined units and confined aquifer units. The aquifers are not named. Carbonate rocks consisting of massive to thinly bedded limestones and dolomites with silty and sandy interbeds represent a deeper hydrogeologic unit in the region. The carbonate rocks range in thickness from about 500 - 25,000 feet. Regional transmittal of groundwater occurs from the carbonate rocks to the upper lake sediment aquifer (Bedinger, et al., 1990).[15,16]

Shallow groundwater flow directions at Wendover AFAF are south, southeast and east.

4.2.2 Groundwater Targets.

Groundwater in the vicinity of Wendover is not used for drinking water, though the town of West Wendover, Nevada derives its drinking water from Johnson Springs, located approximately 25 miles west of the town. Water is piped to a storage tank prior to distribution. There are also springs known to occur in the mountain ranges in the area which produce good quality water; none are considered to be potentially affected by the site.[17]

4.2.3 Groundwater Pathway Conclusion.

The site was scored projecting an observed release to groundwater. This was conducted to develop the maximum score possible that could occur if contaminants have leached from the landfill into the surficial aquifer. Sampling showed very little waste has impacted the groundwater. As noted previously, there is no hard documentation of material quantities deposited in the landfill. The groundwater pathway is an unlikely route of exposure given the very low levels of contaminants and the fact that the water is not used for drinking purposes.

4.3 Surface Water Pathway

The landfill area has a generally flat topographic profile with a mountain range that generally encircles the area along the west. Topographic elevations within the landfill area range from 4240 to approximately 4270 feet above mean sea level (MSL). Surface streams or ponds are not present.[18] Evapotranspiration is considered high in the area and therefore, the low amount of precipitation that occurs on site is generally returned back into the atmosphere.

Contaminants potentially released to the surface water from the landfill are not expected to migrate. This is due to the low precipitation rate and high evapotranspiration rate in the area. There is also no evidence of groundwater to surface water release potential. There are no surface water bodies within 15 miles subject to a pathway of migration from this landfill. Surface water is not used in the area for drinking water purposes. Therefore, there are no human, fish or other animal surface water targets to be identified. No State protected and federally endangered species of birds are known to use landfill as a habitat. The surface water pathway is not considered a pathway of concern for exposure of hazardous materials from the landfill. Therefore, the surface water component will not be further considered.

4.4 Soil Exposure and Air Pathway

There are no residences, schools, daycare facilities or work place environments on or within 200 feet of the site. The site is not paved, access is not restricted, and the landfill cover is sparse vegetation and intact.[19] There is no existing target population that is potentially impacted by either the soil exposure or air pathway. The closest resident is believed to be within a half-mile of the site. Lack of target population essentially eliminates these pathways as potential concerns posed by the landfill.

It should be noted that those levels of arsenic and beryllium exceed RCRA Subpart S action levels but are not considered a significant exposure hazard due to land use and proximity of people.

5.0 EMERGENCY RESPONSE CONSIDERATIONS

The National Contingency Plan [40 CFR 300.415 (b)(2)] authorizes the Environmental Protection Agency to consider emergency response actions at those sites which pose an imminent threat to human health, welfare or the environment. For the following reasons a referral to EPA Region IX's Emergency Response Section is not necessary:

- Hazardous wastes deposited in landfills are overlain by a soil cover;
- Current activities are being conducted to identify and assess the extent of contamination;
- Known levels of contaminants do not pose an imminent or substantial threat.

6.0 CURRENT CONDITION OF THE SITE

The landfill is not used currently to receive wastes of any kind. The vegetation cover is currently of sound integrity.

The Air Force is conducting characterization activities on sites within the facility to assess the current conditions. The City of

West Wendover has also conducted a Baseline Assessment of the site and is pursuing various potential activites for the site, including the expansion and upgrade of the treatment facility.

7.0 SUMMARY

The Utah Test and Training Range Site encompasses 3.5 million acres. The landfill and surrounding area is located west of West Wendover, Nevada and is a small portion of the overall site, 1357.67 acres. The majority of the site is located in Utah and was not evaluated under this Federal Facility Review. All potential routes of exposure were considered. The primary concern was considered to be potential exposure through groundwater consumption, though this route does not pose a threat. No target population exists. The site poses no threat for surface water contaminant migration since surface water in the area does not form permanent, natural streams or lakes. Subsequently there are no targets.

The following are the HRS factors pertinent to this site:

- Groundwater samples confirmed low levels of contaminants in the shallow aquifer;

- Quantities of materials deposited in the lanfill are not known;

- Essentially no target population exists for the various routes of exposure.

REMEDIAL SITE ASSESSMENT DECISION - EPA REGION __

Site Name: UTAH TEST AND TRAINING RANGE **EPA ID#:** NV2 570 090 017

Alias Site Names: HILL AFB

City: WENDOVER **County or Parish:** ______ **State:** NV

Refer to Report Dated: 22 MAY 95 **Report type:** FFR PA

Report developed by: BARBARA BENJOK

DECISION:

|✓| 1. Further Remedial Site Assessment under CERCLA (Superfund) is not required because:

|✓| 1a. Site does not qualify for further remedial site assessment under CERCLA (Site Evaluation Accomplished - SEA)

| | 1b. Site may qualify for further action, but is deferred to: | | RCRA | | NRC

| | 2. Further Assessment Needed Under CERCLA: 2a. (optional) Priority: | | Higher | | Lower

2b. Activity Type: | | PA | | SI | | ESI | | HRS evaluation

| | Other: ______

DISCUSSION/RATIONALE:

Report Reviewed and Approved by: ______ **Signature:** ______ **Date:** ______

Site Decision Made by: JEFF INGLIS **Signature:** [signature] **Date:** 9/29/95

EPA Form # 9100-3

References

1. Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986.

2. Comprehensive Environmental Response and Compensation and Liability Information System (CERCLIS), June 8, 1994.

3. Radian Corporation, Draft Preliminary Assessment/Site Investigation, Wendover Air Force Auxiliary Field, Utah Test and Training Range, December 1993.

4. Radian Corporation, Preliminary Assessment/Site Investigation, Wendover Air Force Auxiliary Field, Utah Test and Training Range, December 1994.

5. Radian Corporation, Work Plan for Preliminary Assessment/Site Investigation, Wendover Air Force Auxiliary Field, Utah Test and Training Range, USAF Contract No. F42650-92-D007, May 15, 1993.

6. Radian Corporation, December 1994.

7. Applied Ecological Services, Inc., Draft Environmental Baseline Survey, Air Industrial Park and Compost Facility for Sewage Sludge and Municipal Solid Waste, 1357.64 Acres Within the Wendover Air Force Auxiliary Field, Elko County, Nevada, November 1994.

8. Nevada Natural Heritage Program, Sensititve Species in the West Wendover, Nevada area, January 1995.

9. National Oceanic and Atmospheric Administration. Daily Normals of Temperature, Precipitation and Heating and Cooling Degree Days, 1961-1990. Climatography of the United States No. 84, Utah, Wendover.

10. Radian Corporation, December 1993.

11. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Precipitation-Frequency Atlas of the Western United States, Volume VII-Nevada, Silver Spring, Maryland, 1973.

12. Ashby, Jim, Desert Research Institute, Reno, Record of Communication, Humidity Data for West Wendover, Nevada, April 28, 1995.

13. Radian Corporation, December 1994.

14. U.S. EPA, Region IX NVS Database, RCRIS, 4.1.1, March 8, 1995.

15. Radian Corporation, December 1994.

16. Water-Resources Appraisal of the Pilot Creek Valley Area, Elko and White Pine Counties, Nevada, Nevada Department of Conservation and Natural Resources, Water Resources - Reconnaissance Series, Report 56, 1941.

17. Nevada Division of Water Resources, Water Rights Database, April 18, 1995.

18. U.S. Geological Survey, 7.5-minute topographic quadrangle map of Wendover, Nevada-Utah, 1972.

19. Gravenstein, Art, May 18, 1995. Record of Communication, NDEP Federal Facilities Branch.

20. Environmental Protection Agency, 40 CFR Part 300, Hazard Ranking System, Final Rule December 14, 1990.

21. Flood Insurance Rate Map, Elko County, Panel 575 of 4375, and Map Index, Federal Emergency Management Agency, revised March 16, 1992 (Index) and Effective Date for Panel 575, February 1, 1984.

22. US EPA, July 1990. *Proposed RCRA Subpart S Action Levels*, 55 Federal Register 30798-30884.

23. Applied Ecological Services, Inc., Draft Environmental Assessment, Air Industrial Park and Compost Facility,, Elko County, Nevada, February 24, 1995.

24. Fox, Janice. City Manager, West Wendover, Nevada. Record of Communication, May 12, 1995.

25. Nevada Division of Water Resources, Correspondence to Toana Corporation, Regarding Water Rights and Usage of Groundwater, Permit no. 44405-06, February 1, 1989.

26. Nisbet, William, Chilton Engineering & Surveying Ltd., Correspondence with Barbara H. Benoy, NDEP, Regarding DWR Permit # 44405, May 2, 1995.

27. Nevada Bureau of Business and Economic Research, "Geodemographic Analysis, Wendover AF Auxiliary Field, Wendover, Elko County, Nevada"; January 1994.

APPENDIX A

Contact Log

Name/Number	Agency/Co. Representing	Date	Discussion
Brian Bonnenfant (702)784-1717	NV Small Business Development Center UNR, Reno	11/17/94	Ordered the demographic data on the UTTR site in W. Wendover, NV
Kevin Cooper (702)687-4245	Nevada Natural Heritage Program Carson City, NV	1/17/95	Requested information on Sensititve Species in the West Wendover, Nevada area. Kevin stated that he would also provide information on the Utah area. He would contact the Utah Natural Heritage Program.
Shane Hirschi, RPM (801)777-8791 (ext-3366)	US Air Force Hill AFB, UT	4/4/95	Requested information re: UTTR site. Told him that NDEP, SF was looking at the site for EPA Reg 9 and that we would generate an FFR on the site using the PA/SI report generated for USAF by Radian Corp.
Robert Stites, RPM (303)294-1974	US EPA, Reg. 8 Denver, CO	4/4/95	Called to let him know what capacity NDEP was working under. Explained that an FFR would be done using the Radian PA/SI generated for the Air Force.
Shane Hirschi, RPM (801)777-8791 (ext-3366)	US Air Force Hill AFB, UT	4/11/95	Discussed specific issues in the PA/SI report. See Record of Communication.
Robert Stites, RPM (303)294-1974	US EPA, Reg. 8 Denver, CO	4/11/95	Asked whether site was on NPL. Answer = yes for the base proper (Hill AFB).
Jim Ashby (702)677-3143	Desert Research Institute Reno, NV	4/28/95	Requested humidity data for W. Wendover, NV

Name/Number	Agency/Co.	Date	Discussion
Jim Farnham (702)687-4380	NV Div. of Water Resources Carson City, NV	4/18/95	Requested water rights information within a 4-mile radius for groundwater and a 15-mile radius for surface water.
William Nisbet (702)738-2121	Chilton Engineering Elko, NV	5/2/95	Contacted him regarding a well designated as quasi-municipal (QM) in NV water rights database. He assured me that there wasn't the water quality for drinking water use and would follow up with a letter of correspondence clarifying the information. (Permit # 44405)
Art Gravenstein (702)687-4670 x(3032)	NDEP Federal Facilities Branch	5/18/95	Cover of landfill is native vegetation. Landfill is cover; cover is intact and effective.
Janice Fox (702)664-3081	City Manager West Wendover, Nevada.	5/12/95	SUBJECT: Utah Test & Training Range Site. Subdivision location adjacent to landfill area; The subdivision appears closer on the map generated by the UNR SBDC, Demographic Report. There are no areas closer than 1.5 miles from the site with respect to closest resident.

<table>
<tr><td colspan="2">RECORD OF
COMMUNICATION</td><td colspan="2">DISCUSSION
FIELD TRIP
CONFERENCE
PHONE CALL
OTHER (SPECIFY)

(Record of item checked above)</td></tr>
<tr><td colspan="2">TO: Rob Stites, RPM
EPA Region 8
(303)294-1974</td><td>FROM: Barbara H. Benoy
NDEP - Superfund
(702) 687-4670
x-3026</td><td>DATE:
4/4/95

TIME:</td></tr>
<tr><td colspan="4">SUBJECT: Utah Test & Training Range Site
West Wendover, Nevada</td></tr>
<tr><td colspan="4">SUMMARY OF COMMUNICATION:

Discussed the site and the available information. Asked him if he knew when the site was listed on the Federal Docket. He did not know. He suggested that I talk to Carol Campbell also, if need more information.

CONCLUSIONS, ACTION TAKEN OR REQUIRED:</td></tr>
<tr><td colspan="2">ROUTE TO:</td><td colspan="2">FILE:</td></tr>
</table>

RECORD OF COMMUNICATION	DISCUSSION FIELD TRIP CONFERENCE PHONE CALL OTHER (SPECIFY) (Record of item checked above)	
TO: Shane Hirschi, RPM USAF, UTTR (801)777-8791 (x-3366)	FROM: Barbara H. Benoy NDEP - Superfund (702) 687-4670 x-3026	DATE: 4/4/95 TIME:

SUBJECT: Utah Test & Training Range (UTTR) Site
West Wendover, Nevada

SUMMARY OF COMMUNICATION: Spoke to him about the site, specifically the Nevada portion of the site. NDEP would be looking at the site to assess the PA/SI report to develop a Federal Facility Review (FFR) report for EPA Region 9. He agreed to send me a copy of the PA/SI report; the PA/SI has been finalized and Art Gravenstein now has a copy of the final.

CONCLUSIONS, ACTION TAKEN OR REQUIRED:

ROUTE TO: FILE:

RECORD OF COMMUNICATION	DISCUSSION FIELD TRIP CONFERENCE PHONE CALL OTHER (SPECIFY) (Record of item checked above)	
TO: Rob Stites, RPM EPA Region 8 (303)294-1974	FROM: Barbara H. Benoy NDEP - Superfund (702) 687-4670 x-3026	DATE: 4/11/95 TIME:

SUBJECT: Utah Test & Training Range Site
West Wendover, Nevada

SUMMARY OF COMMUNICATION:

He informed me that the site is on the NPL, the base proper only of Hill Air Force Base. He couldn't tell me the date the site was placed on the Federal Docket. Suggested that I call Vera Mority at (303)294-7517.

CONCLUSIONS, ACTION TAKEN OR REQUIRED:

ROUTE TO: FILE:

RECORD OF COMMUNICATION	DISCUSSION FIELD TRIP CONFERENCE PHONE CALL OTHER (SPECIFY) (Record of item checked above)	
TO: Shane Hirschi, RPM USAF, UTTR (801)777-8791 (x-3366)	FROM: Barbara H. Benoy NDEP - Superfund (702) 687-4670 x-3026	DATE: 4/11/95 TIME:

SUBJECT: Utah Test & Training Range (UTTR) Site
West Wendover, Nevada

SUMMARY OF COMMUNICATION:
Several questions were posed to Shane to clarify information in the PA/SI report. Q) p. 2-15 states *landfills* (plural), why?
A) typo error

Q) Date the site was listed on the Federal Docket?
A) Unknown

Q) Does an inventory (of any kind) exist which identifies, lists, quantifies, etc. the waste that was deposited into the landfill.
A) No.

Q) Can you provide more specific information regarding the Ordance Area?
A) It is directly south of the landfill. The personnel from NDEP, EPA agreed that visual inspection of the area was adequate to assess whether or not sampling was appropriate. The decision was no.

Q) Can you confirm that site 20 = Ordnance Area and site 18 = landfill area?
A) Yes.

CONCLUSIONS, ACTION TAKEN OR REQUIRED:

ROUTE TO: FILE:

RECORD OF COMMUNICATION	DISCUSSION FIELD TRIP CONFERENCE PHONE CALL OTHER (SPECIFY) (Record of item checked above)	
TO: Jim Ashby Desert Research Institute, Reno, Nevada	FROM: Barbara H. Benoy NDEP - Superfund (702) 687-4670 x-3026	DATE: 4/28/95 TIME:

SUBJECT: Utah Test & Training Range Site
Humidity Data for West Wendover, Nevada,

SUMMARY OF COMMUNICATION:

Humidity ranges from approximately 24% in July to 69% in December. These are averages from the following data: times collected were 5 AM, 11 AM, 5 PM, 11 PM, readings were taken in December and July wihich represent the highest and lowest humidity values for the area: Dec. == 73%, 66%, 60%, 76%; July 33%, 22%, 14%, 27%. These values are based on a 15 year average from 1960-1974.

CONCLUSIONS, ACTION TAKEN OR REQUIRED:

ROUTE TO: FILE: UTTR Site file

<table>
<tr><td colspan="2">RECORD OF
COMMUNICATION</td><td colspan="2">DISCUSSION
FIELD TRIP
CONFERENCE
PHONE CALL
OTHER (SPECIFY)

(Record of item checked above)</td></tr>
<tr><td colspan="2">TO: Janice Fox, City Manager
West Wendover, Nevada.
(702)664-3081</td><td>FROM: Barbara H. Benoy
NDEP - Superfund
(702) 687-4670
x-3026</td><td>DATE:
5/12/95

TIME: 1400</td></tr>
<tr><td colspan="4">SUBJECT: Utah Test & Training Range Site
Subdivision location adjacent to landfill area</td></tr>
<tr><td colspan="4">SUMMARY OF COMMUNICATION:

The subdivision appears closer on the map generated by the UNR SBDC, Demographic Report. According to Ms. Fox, the subdivision is at least 1.5 miles from the landfill boundary. There are no areas closer than 1.5 miles from the site with respect to closest resident.

CONCLUSIONS, ACTION TAKEN OR REQUIRED:</td></tr>
<tr><td colspan="2">ROUTE TO:</td><td colspan="2">FILE: UTTR Site</td></tr>
</table>

<table>
<tr><td colspan="2">RECORD OF
COMMUNICATION</td><td colspan="2">DISCUSSION
FIELD TRIP
CONFERENCE
PHONE CALL
OTHER (SPECIFY)

(Record of item checked above)</td></tr>
<tr><td colspan="2">TO: Art Gravenstein
NDEP
Federal Facilities Branch
(702)687-4670 x(3032)</td><td>FROM: Barbara H. Benoy
NDEP - Superfund
(702) 687-4670
x-3026</td><td>DATE:
5/18/95

TIME: 1400</td></tr>
<tr><td colspan="4">SUBJECT: Utah Test & Training Range
Landfill Cover</td></tr>
<tr><td colspan="4">SUMMARY OF COMMUNICATION:

Cover of landfill is native vegetation. Landfill is cover; cover is intact and effective.

CONCLUSIONS,
ACTION TAKEN OR REQUIRED:</td></tr>
<tr><td>ROUTE TO:</td><td colspan="3">FILE: RRF - UTTR Site</td></tr>
</table>

APPENDIX B

LATITUDE AND LONGITUDE CALCULATION WORKSHEET #2
LI USING ENGINEER'S SCALE (1:60)
NDEP PA/SI

SITE: Utah Test & Training (UTTR) CERCLIS #: NV2570090017

AKA: Wendover Air Force Auxiliary Field SSID: ______

ADDRESS: Immediately southwest of the city of Wendover, Utah

CITY: West Wendover STATE: NV ZIP CODE: 89835

SITE REFERENCE POINT: End of dirt access road leading into landfill area from alternate Hwy. 50 (adjacent to elevation indicator 4260' on topo map).

USGS QUAD MAP NAME: Wendover, NV-Utah TOWNSHIP: 33 N RANGE: 70 E

SCALE: 1:24,000 MAP DATE: 1972 SECTION: Portions of 16,20,21,28,29

MAP DATUM: 1927 MERIDIAN: Mt. Diablo Baseline & Meridian

COORDINATES FROM LOWER RIGHT (SOUTHEAST) CORNER OF 7.5' MAP (attach photocopy):
LONGITUDE: 114° 00' 00" LATITUDE: 40 ° 37' 30"

COORDINATES FROM LOWER RIGHT (SOUTHEAST) CORNER OF 2.5' GRID CELL:

LONGITUDE: 114° 2' 30" LATITUDE: 42 ° 30' 00"

CALCULATIONS: LATITUDE (7.5' QUADRANGLE MAP) 2.5'= 454 RULER DIVISIONS

A) NUMBER OF RULER GRADUATIONS FROM LATITUDE GRID LINE TO SITE REF POINT: 228

B) MULTIPLY (A) BY 0.3304 (150/454) TO CONVERT SECONDS: A x 0.3304 = 75.33"

C) EXPRESS IN MINUTES AND SECONDS (1' = 60"): 1' 15.33"

D) ADD TO STARTING LATITUDE: 42° 30' 00. " + 1' 15.33" =

SITE LATITUDE: 42° 31' 15.33"

CALCULATIONS: LONGITUDE (7.5' QUADRANGLE MAP) 2.5' = 344 RULER DIVISIONS

A) NUMBER OF RULER GRADUATIONS FROM RIGHT LONGITUDE LINE TO SITE REF POINT: 138

B) MULTIPLY (A) BY 0.4360 (150/344) TO CONVERT TO SECONDS: A x 0.4360 = 60.17"

C) EXPRESS IN MINUTES AND SECONDS (1' = 60"): 1' 00.17"

D) ADD TO STARTING LONGITUDE: 114° 2' 30. " + 1' 00.17" =

SITE LONGITUDE: 114° 3' 30.17"

INVESTIGATOR: B. H. Benoy DATE: January 4, 1995

APPENDIX C

***** CONFIDENTIAL *****
***** PREDECISIONAL DOCUMENT *****

SUMMARY SCORESHEET FOR COMPUTING PROJECTED HRS SCORE

SITE NAME: UTTR

CITY, COUNTY: West Wendover, Elko

EPA ID #: NV 2570090017 EVALUATOR: Bonay

PROGRAM ACCOUNT #: ______ DATE: 4/21/95

Lat/ Long: 42° 31' 15.33" / 114° 3' 30.17" T/R/S: Within T, 32 + 33N, R 69 + 70E, S 16, 20, 21, 28, 29

THIS SCORESHEET IS FOR A: PA ___ SI ___ Other (Specify) X FFR

RCRA STATUS (check all that apply):

___ Generator ___ Small Quantity Generator ___ Transporter ___ TSDF

X Not Listed in RCRA Database as of (date of printout) 3 / 8 / 95

STATE SUPERFUND STATUS:

___ DTSC Annual Work Plan (formerly BEP) (date) ___/___/___

___ WQARF (date) ___/___/___ No State Superfund Status (date) ___/___/___

	S pathway	S^2 pathway
Groundwater Migration Pathway Score (S_{gw})	0.6	0.36
Surface Water Migration Pathway Score (S_{sw})	.19	--
Soil Exposure Pathway Score (S_s)	--	--
Air Migration Pathway Score (S_a)	--	--
$S^2_{gw} + S^2_{sw} + S^2_s + S^2_a$	XXXXXXXXXXXXXX XXXXXXXXXXXXXX	0.36
$(S^2_{gw} + S^2_{sw} + S^2_s + S^2_a) / 4$	XXXXXXXXXXXXXX XXXXXXXXXXXXXX	0.09
$\sqrt{(S^2_{gw} + S^2_{sw} + S^2_s + S^2_a) / 4}$	XXXXXXXXXXXXXX XXXXXXXXXXXXXX	0.3

* Pathway evaluated, but not assigned a score (explain):

The pathways are all low scoring. Essentially there are no targets to be identified for any pathways of concern.

GROUNDWATER MIGRATION PATHWAY SCORESHEET

Factor Categories and Factors

Likelihood of Release	Maximum Value	Score	Rationale	Data Qual.
1. Observed Release	550	550	1	E
2. Potential to Release				
2a. Containment	10			
2b. Net Precipitation	10			
2c. Depth to Aquifer	5			
2d. Travel Time	35			
2e. Potential to Release [Lines 2a x (2b+2c+2d)]	500			
3. Likelihood of Release (Line 1 or 2e)	550	550		
Waste Characteristics				
4. Toxicity/Mobility	a	10,000	2	
5. Hazardous Waste Quantity	a	10	3	
6. Waste Characteristics (lines 4 x 5, then use Table 2-7)	100	18		
Targets				
7. Nearest Well	50	0	4	
8. Population[d]				
8a. Level I Concentrations	b	0		
8b. Level II Concentrations	b	0		
8c. Potential Contamination	b	0		
8d. Population (lines 8a+8b+8c)	b	0	5	
9. Resources	5	5	6	
10. Wellhead Protection Area	20	0		
11. Targets (lines 7+8d+9+10)	b	5		
12. Aquifer Score [(Lines 3 x 6 x 11)/82,500][c]	100	0.6		

Groundwater Migration Pathway Score

13. Pathway Score (Sgw), (highest value from line 12 for all aquifers evaluated)	100	$\boxed{0.6}$[c]		

a Maximum value applies to waste characteristics category.
b Maximum value not applicable.
c Do not round to the nearest integer.
d Use additional tables.

Aquifer Evaluated Great Salt Lake Basin - Surficial Aquifer

GROUNDWATER PATHWAY CALCULATIONS

8. Population

Actual Contamination

Well Identifier	Contaminant Detected	Concentration (Note Units)	Benchmark	(A) Apportioned Population Well Serves	(B) Level* Multip.	(A x B)
					Sum (AXB) Level I	
					Sum (AXB) Level II	∅

* Multipliers
- Level I = 10
- Level II = 1

Potential Contamination

Distance (miles)	Total Number of Wells Within Distance Ring	Total Population Served by Wells Within Distance Ring	Distance-Weighted Population Values "Other Than Karst"* (Table 3-12) (A)
0 to 1/4			
>1/4 to 1/2			
>1/2 to 1			
>1 to 2			
>2 to 3			
>3 to 4			
		Sum (A)	0

Potential contamination = $\frac{\text{Sum (A)}}{10}$ = ________

* For drinking water wells that draw from a karst aquifer, see the Distance-Weighted Population Values for "Karst" in Table 3-12.

Aquifer Evaluated Great Salt Lake Basin - Surficial Aquifer

SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORESHEET

Factor Categories and Factors

DRINKING WATER THREAT

	Likelihood of Release	Maximum Value	Score	Rationale	Data Qual.
1.	Observed Release	550			
2.	Potential to Release by Overland Flow				
	2a. Containment	10	10	8	
	2b. Runoff	25	7	9	
	2c. Distance to Surface Water	25	3	10	
	2d. Potential to Release by Overland Flow [lines 2a x (2b+2c)]	500	100		
3.	Potential to Release by Flood				
	3a. Containment (Flood)	10	10	11	
	3b. Flood Frequency	50	7	12	
	3c. Potential to Release by Flood (lines 3a x 3b)	500	70		
4.	Potential to Release (Lines 2d+3c, subject to a maximum of 500)	500	170		
5.	Likelihood of Release (Line 1 or 4)	550	170		

	Waste Characteristics	Maximum Value	Score	Rationale	Data Qual.
6.	Toxicity/Persistence	a	10,000	13	
7.	Hazardous Waste Quantity	a	10	14	
8.	Waste Characteristics (lines 6 x 7, then assign a value from Table 2-7)	100	18		

	Targets	Maximum Value	Score	Rationale	Data Qual.
9.	Nearest Intake	50	0	15	
10.	Population				
	10a. Level I Concentrations	b	—		
	10b. Level II Concentrations	b	—		
	10c. Potential Contamination	b	—		
	10d. Population (lines 10a + 10b+10c)	b	—		
11.	Resources	5	5	16	
12.	Targets (lines 9+10d+11)	b	5		

	Drinking Water Threat Score	Maximum Value	Score	Rationale	Data Qual.
13.	Drinking Water Threat [(Lines 5 x 8 x 12)/82,500, subject to a maximum of 100]	100	0.19		

SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORESHEET (CONTINUED)

Factor Categories and Factors

HUMAN FOOD CHAIN THREAT

Likelihood of Release	Maximum Value	Score	Rationale	Data Qual.
14. Likelihood of Release (Same value as line 5)	550			
Waste Characteristics				
15. Toxicity/Persistence/ Bioaccumulation	a			
16. Hazardous Waste Quantity	a			
17. Waste Characteristics (Toxicity/Persistence x Hazardous Waste Quantity x Bioaccumulation, then assign a value from Table 2-7)	1,000			
Targets				
18. Food Chain Individual[d]	50			
19. Population				
19a. Level I Concentrations	b			
19b. Level II Concentrations	b			
19c. Potential Human Food Chain Contamination	b			
19d. Population (lines 19a+19b+19c)	b			
20. Targets (lines 18+19d)	b			
Human Food Chain Threat Score				
21. Human Food Chain Threat [(Lines 14 x 17 x 20)/82,500 subject to a maximum of 100]	100			

SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORESHEET (CONTINUED)

Factor Categories and Factors

ENVIRONMENTAL THREAT

	Likelihood of Release	Maximum Value	Score	Rationale	Data Qual.
22.	Likelihood of Release (Same value as line 5)	550	170		
	Waste Characteristics				
23.	Ecosystem Toxicity/Persistence/ Bioaccumulation	a			
24.	Hazardous Waste Quantity	a			
25.	Waste Characteristics (Ecosystem Tox./Persistence x Hazardous Waste Quantity x Bioaccumulation, then assign a value from Table 2-7)	1,000			
	Targets				
26.	Sensitive Environments[d]				
	26a. Level I Concentrations	b			
	26b. Level II Concentrations	b			
	26c. Potential Contamination	b			
	26d. Sensitive Environments (lines 26a+26b+26c)	b			
27.	Targets (Value from line 26d)	b			
	Environmental Threat Score				
28.	Environmental Threat Score [(lines 22 x 25 x 27)/82.500 subject to a maximum of 60]	60			

SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORE FOR A WATERSHED

		Maximum Value	Score
29.	Watershed Score [(Lines 13+21+28), subject to a maximum of 100]	100	$\boxed{}$ c

SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORE

		Maximum Value	Score
30.	Component Score (Sof) (Highest score from Line 29 for all watersheds evaluated, subject to a maximum of 100)	100	$\boxed{}$ c

a Maximum value applies to waste characteristics category.
b Maximum value not applicable.
c Do not round to the nearest integer.
d Use additional tables

SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT CALCULATIONS

12. Drinking Water Targets

Actual Contamination

Intake	Contaminant Detected	Concentration (Note Units)	Benchmark	(A) Apportioned Population Intake Serves	(B) Level* Multip.	(A x B)

* Level Multipliers
- Level I = 10
- Level II = 1

Sum (A x B) Level I | ______

Sum (A x B) Level II | ______

Potential Contamination

Type of Surface Water Body (Dilution)	(A) Dilution-Weighted Population Value (Table 4-14)
< 10 cfs	
10 to 100 cfs	
> 100 to 1,000 cfs	
> 1,000 to 10,000 cfs	
> 10,000 to 100,000 cfs	
Shallow ocean zone (depth < 20 ft)	
Moderate ocean zone (depth 20 to 200 ft)	
Deep ocean zone (depth > 200 ft)	
3-mile mixing zone in quiet flowing river $\geq$ 10 cfs	
Sum (A)	

Potential Contamination = $\frac{\text{Sum (A)}}{10}$ = ______

SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT CALCULATIONS (CONTINUED)

20. Food Chain Targets

Actual Contamination

Fishery	Contaminant	Concentration	Benchmark	(A) Assigned Population Value (Table 4-18)	(B) Level Multiplier*	(A x B)

Sum (A x B) Level I ______

Sum (A x B) Level II ______

* Level Multipliers
- Level I = 10
- Level II = 1

Potential Contamination

Fishery	Production (lb/yr)	(P) Assigned Population Value (Table 4-18)	Average Stream Flow at Fishery (cfs)	(DW) Dilution Weighting Factor (Table 4-13)	(P x DW)

Sum (P x DW) ______

Fisheries Subject to Potential Contamination = $\frac{\text{Sum (P x DW)}}{10}$ = ______

SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT CALCULATIONS (CONTINUED)

27. Environmental Targets

Actual Contamination

Sensitive Environment or Wetland Length (miles)	Contaminant	Concentration	Benchmark	(A) Assigned Value (Table 4-23 and/or 4-24)	(B) Level Multiplier*	(A x B)
					Sum (A x B) Level I	
					Sum (A x B) Level II	

* Level Multipliers
- Level I = 10
- Level II = 1

Potential Contamination

Sensitive Environment or Wetland Length (miles)	(A) Assigned Value (Table 4-23 and/or 4-24)	Average Stream Flow (cfs)	(DW) Dilution Weighting Factor (Table 4-13)	(A x DW)
			Sum of (A x DW)	

Potential contamination = $\frac{\text{Sum (A x DW)}}{10}$ = ________

GROUNDWATER TO SURFACE WATER MIGRATION COMPONENT SCORESHEET

Factor Categories and Factors

DRINKING WATER THREAT

	Likelihood of Release to Aquifer	Maximum Value	Score	Rationale	Data Qual.
1.	Observed Release	550			
2.	Potential to Release				
	2a. Containment	10			
	2b. Net Precipitation	10			
	2c. Depth to Aquifer	5			
	2d. Travel Time	35			
	2e. Potential to Release [lines 2a x (2b+2c+2d)]	500			
3.	Likelihood of Release (Line 1 or 2e)	550			
	Waste Characteristics				
4.	Toxicity/Mobility/Persistence	a			
5.	Hazardous Waste Quantity	a			
6.	Waste Characteristics (lines 4 x 5, then assign a value from Table 2-7)	100			
	Targets				
7.	Nearest Intake	50			
8.	Population[d]				
	8a. Level I Concentrations	b			
	8b. Level II Concentrations	b			
	8c. Potential Contamination	b			
	8d. Population (lines 8a+8b+8c)	b			
9.	Resources	5			
10.	Targets (Lines 7+8d+9)	b			
	Drinking Water Threat Score				
11.	Drinking Water Threat [(Lines 3 x 6 x 10)/82,500 subject to a maximum of 100]	100			

GROUNDWATER TO SURFACE WATER MIGRATION COMPONENT SCORESHEET (CONTINUED)

Factor Categories and Factors

HUMAN FOOD CHAIN THREAT

	Likelihood of Release	Maximum Value	Score	Rationale	Data Qual.
12.	Likelihood of Release (Same Value as Line 3)	550			
	Waste Characteristics				
13.	Toxicity/Mobility/Persistence/ Bioaccumulation	a			
14.	Hazardous Waste Quantity	a			
15.	Waste Characteristics (Toxicity/Mobility/Persistence x Hazardous Waste Quantity x Bioaccumulation, then assign a value from Table 2-7)	1,000			
	Targets				
16.	Food Chain Individual	50			
17.	Population[d]				
	17a. Level I Concentrations	b			
	17b. Level II Concentrations	b			
	17c. Potential Human Food Chain Contamination	b			
	17d. Population (Lines 17a+17b+17c)	b			
18..	Targets (Lines 16+17d)	b			
	Human Food Chain Threat Score				
19.	Human Food Chain Threat [(Lines 12 x 15 x 18)/82,500 subject to a maximum of 100]	100			

GROUNDWATER TO SURFACE WATER MIGRATION COMPONENT SCORESHEET (CONTINUED)

Factor Categories and Factors

ENVIRONMENTAL THREAT

	Likelihood of Release	Maximum Value	Score	Rationale	Data Qual.
20.	Likelihood of Release (Same Value as Line 3)	550			
	Waste Characteristics				
21.	Ecosystem Toxicity/Mobility/ Persistence/Bioaccumulation	a			
22.	Hazardous Waste Quantity	a			
23.	Waste Characteristics (Eco. Tox./Mob./Pers.x Hazardous Waste Quantity x Bioaccumulation, then assign a value from Table 2-7)	1,000			
	Targets				
24.	Sensitive Environments[d]				
	24a. Level I Concentrations	b			
	24b. Level II Concentrations	b			
	24c. Potential Contamination	b			
	24d. Sensitive Environments (lines 24a+24b+24c)	b			
25.	Targets (Value from line 24d)	b			
	Environmental Threat Score				
26.	Environmental Threat Score [(lines 20 x 23 x 25)/82,500 subject to a maximum of 60]	60			

GROUNDWATER TO SURFACE WATER MIGRATION COMPONENT SCORE FOR A WATERSHED

27.	Watershed Score [(Lines 11+19+26), subject to a maximum of 100]	100	[c]

GROUNDWATER TO SURFACE WATER MIGRATION COMPONENT SCORE

28.	Component Score (Sof) (Highest score from Line 27 for all watersheds evaluated, subject to a maximum of 100)	100	[c]

a Maximum value applies to waste characteristics category.
b Maximum value not applicable.
c Do not round to the nearest integer.
d Use additional tables.

GROUNDWATER TO SURFACE WATER MIGRATION COMPONENT CALCULATIONS

10. Drinking Water Targets

Actual Contamination

Intake	Contaminant Detected	Concentration (Note Units)	Benchmark	(A) Apportioned Population Intake Serves	(B) Level Multip.*	(A x B)
				Sum (A x B) Level I		
				Sum (A x B) Level II		

* Level Multipliers
- Level I = 10
- Level II = 1

Potential Contamination

Type of Surface Water Body (Dilution)	(A) Dilution-weighted Adjustment Values (Table 4-27)	(B) Dilution-weighted Population Values (Table 4-14)	(A x B)
< 10 cfs			
10 to 100 cfs			
> 100 to 1,000 cfs			
> 1,000 to 10,000 cfs			
> 10,000 to 100,000 cfs			
Shallow ocean zone (depth < 20 ft)			
Moderate ocean zone (depth 20 to 200 ft)			
Deep ocean zone (depth > 200 ft)			
3-mile mixing zone in quiet flowing river $\geq$ 10 cfs			
		Sum (A X B)	

Potential Contamination = $\frac{\text{Sum (A x B)}}{10}$ = ________

GROUNDWATER TO SURFACE WATER MIGRATION COMPONENT CALCULATIONS (CONTINUED)

20. **Food Chain Targets**

Actual Contamination

Fishery	Contaminant	Concen-tration	Benchmark	(A) Assigned Population Value (Table 4-18)	(B) Level* Multiplier	(A x B)

* Level Multipliers
- Level I = 10
- Level II = 1

Sum (A x B) Level I ______

Sum (A x B) Level II ______

Potential Contamination

Fishery	Production (lb/yr)	(P) Assigned Population Value (Table 4-18)	Average Stream Flow at Fishery (cfs)	(DW) Dilution Weighting Factor (Table 4-13)	(DA) Dilution Weight Adjustment Factor (Table 4-27)	(PxDWxDA)

Sum (PxDWxDA) ______

Fisheries Subject to Potential Contamination = $\frac{\text{Sum (PxDWxDA)}}{10}$ = ______

GROUNDWATER TO SURFACE WATER MIGRATION COMPONENT CALCULATIONS (CONTINUED)

27. **Environmental Targets**

Actual Contamination

Sensitive Environment or Wetland Length (miles)	Contaminant	Concen- tration	Benchmark	(A) Assigned Value (Table 4-23 and/or 4-24)	(B) Level* Multip.	(A x B)

* Level Multipliers
- Level I = 10
- Level II = 1

Sum (A x B) Level I ______

Sum (A x B) Level II ______

Potential Contamination

Sensitive Environment or Wetland Length (miles)	(A) Assigned Value (Table 4-23 and/or 4-24)	Average Stream Flow (cfs)	(DW) Dilution Weighting Factor (Table 4-13)	(DA) Dilution Weighting Adjustment Factor (Table 4-27)	(AxDWxDA)

Sum of (AxDWxDA) ______

Potential contamination = $\frac{\text{Sum (AxDWxDA)}}{10}$ = ______

surface
No soil samples
collected

SOIL EXPOSURE PATHWAY SCORESHEET

Factor Categories and Factors

RESIDENT POPULATION THREAT

		Maximum Value	Score	Rationale	Data Qual.
	Likelihood of Exposure				
1.	Likelihood of Exposure	550			
	Waste Characteristics				
2.	Toxicity	a			
3.	Hazardous Waste Quantity	a			
4.	Waste Characteristics	100			
	Targets				
5.	Resident Individual	50			
6.	Resident Population				
	6a. Level I Concentrations	b			
	6b. Level II Concentrations	b			
	6c. Resident Population (lines 6a+6b)	b			
7.	Workers	15			
8.	Resources	5			
9.	Terrestrial Sensitive Environments	c			
10.	Targets (lines 5+6c+7+8+9)	b			
	Resident Population Threat Score				
11.	Resident Population Score (lines 1 x 4 x 10)	b			

NEARBY POPULATION THREAT

		Maximum Value	Score	Rationale	Data Qual.
	Likelihood of Exposure				
12.	Attractiveness/Accessibility	100			
13.	Area of Contamination	100			
14.	Likelihood of Exposure	500			
	Waste Characteristics				
15.	Toxicity	a			
16.	Hazardous Waste Quantity	a			
17.	Waste Characteristics	100			
	Targets				
18.	Nearby Individual	1			
19.	Population Within 1-Mile[e]	b			
20.	Targets (lines 18+19)	b			

SOIL EXPOSURE PATHWAY SCORESHEET (CONTINUED)

Factor Categories and Factors

	Nearby Population Threat Score	Maximum Value	Score	Rationale	Data Qual.
21.	Nearby Population Threat (lines 14 x 17 x 20)	b			

SOIL EXPOSURE PATHWAY SCORE

22.	Soil Exposure Pathway Score (Ss), [lines (11+21)/82,500 subject to a maximum of 100]	100	$\boxed{}$ d

a Maximum value applies to waste characteristics category.
b Maximum value not applicable.
c No specific maximum value applies to this factor. However, pathway score based solely on sensitive environments is limited to a maximum of 60.
d Do not round to the nearest integer.
e Use additional tables.

SOIL EXPOSURE CALCULATIONS

20. Nearby Population Targets

Distance (miles)	Total Population Within Distance Ring	(P) Distance-Weighted Population Values (Table 5-10)
0 to 1/4	______	______
>1/4 to 1/2	______	______
>1/2 to 1	______	______
	Sum (P)	______

Nearby Population Threat factor value $\frac{\text{Sum (P)}}{10}$ = ______

AIR MIGRATION PATHWAY SCORESHEET

Factor Categories and Factors

Likelihood of Release	Maximum Value	Score	Rationale	Data Qual.
1. Observed Release	550			
2. Potential to Release[e]				
2a. Gas Potential	500			
2b. Particulate Potential	500			
2c. Potential to Release (higher of lines 2a and 2b)	500			
3. Likelihood of Release (Line 1 or 2c)	550	550		
Waste Characteristics				
4. Toxicity/Mobility	a	10,000		
5. Hazardous Waste Quantity	a	10		
6. Waste Characteristics (lines 4 x 5, then use Table 2-7)	100	18		
Targets				
7. Nearest Individual	50	1		
8. Population[e]				
8a. Level I Concentrations	b	—		
8b. Level II Concentrations	b	—		
8c. Potential Contamination[e]	b	3.71		
8d. Population (8a+8b+8c)	b	3.71		
9. Resources	5	0		
10. Sensitive Environments[e]				
10a. Actual Contamination	c	0		
10b. Potential Contamination	c	—		
10c. Sensitive Environments (lines 10a+10b)	c	—		
11. Targets (Lines 7+8d+9+10c)	b	4.71		

Air Pathway Migration Score

	Maximum Value	Score
12. Air Pathway Score (Sa) [(lines 3 x 6 x 11)/82,500]	100	$\boxed{0.6}$ [d]

a Maximum value applies to waste characteristics category.
b Maximum value not applicable.
c No specific maximum value applies to factor. However, pathway score based solely on sensitive environments is limited to a maximum of 60.
d Do not round to nearest integer.
e Use additional tables.

AIR PATHWAY CALCULATIONS (CONTINUED)

8. Potential Contamination

Distance (miles)	Total Population Within Distance Ring	(A) Distance-Weighted Population Value (Table 6-17)
On a source (0)		
>0 to 0.25	13	4
>0.25 to 0.5	87	3
>0.5 to 1	1130	26
>1 to 2	629	3
>2 to 3	284	0.4
>3 to 4	356	0.7
	Sum of (A) =	37.1

Air Potential Contamination Factor Value = $\frac{\text{Sum of (A)}}{10}$ = 3.71

10. Sensitive Environments

Actual Contamination

Wetland or Type of Sensitive Environment	(A) Sensitive Environment Rating Value (Table 4-23)	(B) Wetland Rating Value (Table 6-18)	(A + B)

Actual Contamination Factor Value [sum (A + B)] ______

AIR PATHWAY CALCULATIONS (CONTINUED)

Potential Contamination

Wetland or Type of Sensitive Environment	(A) Sensitive Environment Rating Value (Table 4-23)	(B) Wetland* Rating Value (Table 6-18)	Distance (miles)	(DW) Distance Weights (Table 6-15)	DW x (A + B)
				Sum DW x (A + B)	

Potential Contamination
Sensitive Environments Factor Value = $\frac{\text{Sum DW x (A + B)}}{10}$ = ____________

* Only assign a Wetland Rating Value once for each wetland within a distance category.

AIR PATHWAY CALCULATIONS

2. Potential to Release

Gas Potential to Release

	Source Type (Name)	Gas Containment Factor Value (Table 6-3)	Gas Source Type Factor Value (Table 6-4)	Gas Migration Potential Factor Value (Table 6-7)	Sum	Gas Source Value
		(A)	(B)	(C)	(B+C)	A x (B+C)
1.						
2.						
3.						
4.						

Gas Potential to Release Factor Value (Select the highest Gas Source Value) ______

Particulate Potential to Release

	Source Type (Name)	Particulate Containment Factor Value (Table 6-9)	Particulate Source Type Factor Value (Table 6-4)	Particulate Migration Potential Factor Value (Figure 6-2)	Sum	Particulate Source Value
		(A)	(B)	(C)	(B+C)	A x (B+C)
1.						
2.						
3.						
4.						

Particulate Potential to Release Factor Value (Select the highest Particulate Source Value) ______

RATIONALE

Groundwater

1. A release to groundwater is projected in order to generate the maximum score possible under the groundwater pathway. This projection is feasible since the landfill has existed since 19**. Groundwater contamination would have to be substantiated to justify a groundwater release. This projection is a hypothetical scenario.

2. There are no specific lists or documents which inventory the materials that were placed in the landfill. Personal interviews of several individuals who worked at the facility identify some materials, including hazardous materials that were disposed in the landfill. Those materials evaluated include: spent solvents, plating mill wastes, fuels, paint waste, asbestos and miscellaneous construction rubble. The contaminants of potential concern include metals, asbestos, volatile organic compounds (VOCs) and petroleum hydrocarbons.

   Asbestos will be selected for evaluating the score due to its high toxicity/mobility score. Score = 10,000

3. The hazardous waste quantity has not been adequately defined. Therefore a value of 10 is assigned per the HRS Rules & Regulations, Fed. Reg., Vol. 55, No. 241, p 51592, left column, 2nd bullet. Score = 10.

4. No drinking water wells are located within a four mile radius of the landfill. The water rights database maintained by Division of Water Resources identifies a quasi-municipal well located within a two mile radius of the site. Further investigation determined that this well has never been used for drinking water purposes due to water quality. Score = 0.

5. There is no human population currently consuming groundwater from the potentially affected aquifer in the vicinity of the landfill site. Score = 0.

6. Wells within a four mile radius are used for both irrigation and stock watering. Score = 5.

7. There is no designated Wellhead Protection Area within the vicinity of the landfill site. Score = 0.

Surface Water

8. There is no evidence of a liner or of diking at this landfill. It is assumed that hazardous materials have been disposed within the landfill. Score = 10.

9. To develop the runoff matrix score, the drainage area is estimated to be greater that 1,000 feet. The soil type is

assumed to be moderately to fine-textured soils with low to very low infiltration rates. The maximum (highest) scoring scenario will be used to simulate worse-case scenario. The two-year, 24-hour precipitation is estimated at one 1 inch. Scores are 4 for drainage area and D for soil group designations, yielding a total score of 7.

10. The distance to surface water is known to be greater than 1.5 miles and is expected to be greater than 2 miles. Therefore, the score is taken at 3 as per Table 4-7 of the HRS Rules and Regulations.

11. There is no run-on control and runoff management system, functioning or otherwise. Therefore, the score is assigned at 10.

12. The site is located in an area of minimal flooding as defined by the National Insurance Rate Maps, published by FEMA. However, to project a worse-case scenario, the area is assumed to be within a 500-year flood plain.

13. There are no specific lists or documents which inventory the materials that were placed in the landfill. Personal interviews of several individuals who worked at the facility identify some materials, including hazardous materials that were disposed in the landfill. Those materials evaluated include: spent solvents, plating mill wastes, fuels, paint waste, asbestos and miscellaneous construction rubble. The contaminants of potential concern include metals, asbestos, volatile organic compounds (VOCs) and petroleum hydrocarbons.

    Asbestos will be selected for evaluating the score due to its high toxicity/persistence score. Score = 10,000

14. The hazardous waste quantity has not been adequately defined. Therefore a value of 10 is assigned per the HRS Rules & Regulations, Fed. Reg., Vol. 55, No. 241, p 51592, left column, 2nd bullet. Score = 10.

15. There are no surface water intakes within the 15-mile radius or 15 miles downstream of the landfill which are used for drinking water purposes. Therefore, a score of 0 is assigned.

16. There are surface water uses in the vicinity of the landfill that are used for stock watering. Therefore, the score will be assessed at 5.

17.

Surface Water Overland/Flood Migration Component:

Not evaluated since there are no target populations which might be subject to food chain exposure.

Reference 4

Ref. 4

PA/SI Review 5/22/95

3461
Utah Test & Training Range

279-102-07-01

PRELIMINARY ASSESSMENT/SITE INVESTIGATION
WENDOVER AIR FORCE AUXILIARY FIELD
HILL AIR FORCE RANGE

FINAL

Volume 1

Prepared for:

OO-ALC/EMR
Mr. Shane Hirschi
7274 Wardleigh Road
Hill AFB, Utah 84056-5127

Prepared by:

Radian Corporation
4021 south 700 East, Suite 600
Salt Lake City, Utah 84107

December 1994

TABLE OF CONTENTS

Page

Volume I

SUMMARY OF FINDINGS S-1

1.0 INTRODUCTION 1-1

1.1 Objectives 1-1
1.2 Project Approach 1-1
1.3 Previous Investigations 1-1
1.4 Report Organization 1-7

2.0 ENVIRONMENTAL SETTING 2-1

2.1 Site Description 2-1
2.1.1 Geographical Setting 2-1
2.1.2 Climate 2-1
2.1.3 Surface Soils 2-1
2.1.4 Subsurface Soils 2-1
2.1.5 Surface Water 2-1
2.1.6 Groundwater 2-1
2.2 Site History 2-8
2.2.1 Primary Activities 2-8
2.2.2 Past and Current Land Uses 2-11
2.2.3 Wastes Generated 2-12

3.0 SITE INVESTIGATION 3-1

3.1 Objectives and Summary 3-1
3.2 Personnel Interviews 3-1
3.3 Cone Penetrometer Testing 3-7
3.3.1 Objective 3-7
3.3.2 Locations 3-7
3.3.3 Results 3-7
3.4 Soil Sampling 3-16
3.4.1 Objectives 3-16
3.4.2 Locations 3-16
3.4.3 Results 3-17
3.5 Groundwater Sampling 3-22
3.5.1 Objective 3-22
3.5.2 Locations 3-22
3.5.3 Results 3-22
3.6 Surveying 3-32

TABLE OF CONTENTS
(CONTINUED)

Page

4.0 PATHWAY AND ENVIRONMENTAL HAZARD ASSESSMENT 4-1

4.1 Conceptual Site Model 4-1
4.2 Soil 4-1
4.2.1 Impacts to Soil 4-1
4.2.2 Likelihood of Exposure 4-4
4.3 Surface Water 4-4
4.3.1 Potential for Release to Surface Water 4-4
4.3.2 Likelihood of Exposure 4-4
4.4 Groundwater 4-6
4.4.1 Releases to Groundwater 4-6
4.4.2 Likelihood of Exposure 4-7
4.5 Air 4-7
4.5.1 Potential for Release to Air 4-7
4.5.2 Likelihood of Exposure 4-7

5.0 SITE EVALUATION AND SCORING 5-1

5.1 Wendover Air Force Auxiliary Field 5-1
5.2 Hill Air Force Range 5-3

6.0 RECOMMENDATIONS 6-1

7.0 REFERENCES 7-1

LIST OF TABLES

		Page
1	Summary of Sites Evaluated, Wendover Air Force Auxiliary Field	S-2
2	Summary of Sites Identified, Hill Air Force Range	S-4
3	Maximum Concentrations of Contaminants Exceeding Regulatory Criteria, Wendover Air Force Auxiliary Field	S-9
4	Conclusions and Recommendations for Sites Evaluated, Wendover Air Force Auxiliary Field	S-12
1-1	Major Factors Considered During Preliminary Assessment/Site Investigation, Wendover Air Force Auxiliary Field and Hill Air Force Range	1-6
2-1	Meteorological Data, Wendover Air Force Auxiliary Field and Hill Air Force Range	2-4
2-2	Summary of Potential Contaminant Source Types, Wastes Generated, and Contaminants of Potential Concern, Wendover Air Force Auxiliary Field and Hill Air Force Range	2-15
3-1	Site Investigation Activities, Wendover Air Force Auxiliary Field	3-3
3-2	Summary of Soil and Groundwater Sample Analyses, Wendover Air Force Auxiliary Field	3-5
3-3	Sample Numbering Logic, Wendover Air Force Auxiliary Field	3-6
3-4	Results of Gas Chromatograph Screening of Soil Gas and Groundwater Samples Collected During Cone Penetrometer Testing, Wendover Air Force Auxiliary Field	3-8
3-5	Distribution of Organic Contaminants in Soil (mg/kg) Exceeding RCRA Subpart S Action Levels, Wendover Air Force Auxiliary Field	3-18
3-6	Distribution of Inorganic Contaminants in Soil (mg/kg) Exceeding RCRA Subpart S Action Levels, Wendover Air Force Auxiliary Field	3-19
3-7	Physical Properties of Soils, Wendover Air Force Auxiliary Field	3-23

LIST OF TABLES
(CONTINUED)

Page

3-8 Distribution of Organic Contaminants in Groundwater (μg/L), Wendover Air Force Auxiliary Field 3-26

3-9 Distribution of Inorganic Contaminants in Groundwater (mg/L) Exceeding Maximum Contaminant Levels, Wendover Air Force Auxiliary Field 3-31

4-1 Resident and Worker Populations, Wendover Air Force Auxiliary Field and Hill Air Force Range 4-5

5-1 Summary of Results of Site Scoring, Wendover Air Force Auxiliary Field and Hill Air Force Range 5-2

LIST OF FIGURES

Page

1 Conceptual Site Model - Wendover Air Force Auxiliary Field S-6

2 Delineation of Sites, Wendover Air Force Auxiliary Field S-7

1-1 Location of Wendover Air Force Auxiliary Field and Hill Air Force Range 1-2

1-2 Site Map of Wendover Air Force Auxiliary Field, Utah and Nevada 1-3

1-3 Site Map of Hill Air Force Range, Utah 1-4

1-4 Project Approach for Preliminary Assessment/Site Investigation, Wendover Air Force Auxiliary Field and Hill Air Force Range 1-5

2-1 Physiographic Features, Wendover Air Force Auxiliary Field, Utah 2-2

2-2 Physiographic Features, Hill Air Force Range 2-3

2-3 Surface Soils, Wendover Air Force Auxiliary Field 2-5

2-4 Surface Soils, Hill Air Force Range 2-6

2-5 Subsurface Soil, Wendover Air Force Auxiliary Field 2-7

2-6 Primary Activities at Wendover Air Force Auxiliary Field and Hill Air Force Range 2-9

2-7 Historical Site Map of Wendover Air Force Auxiliary Field, Utah and Nevada 2-10

2-8 Current Land Uses, Wendover Air Force Auxiliary Field 2-13

2-9 Current Land Owners, Wendover Air Force Auxiliary Field 2-14

3-1 Delineation of Sites, Wendover Air Force Auxiliary Field 3-2

4-1 Conceptual Site Model - Wendover Air Force Auxiliary Field 4-2

4-2 Conceptual Framework for Wendover Air Force Auxiliary Field and Hill Air Force Range 4-3

LIST OF FIGURES
(CONTINUED)

Plate 1 Cone Penetrometer Testing and Soil Gas and Groundwater Screening Locations, Wendover Air Force Auxiliary Field

Plate 2 Borehole and Surface Soil Sampling Locations, Wendover Air Force Auxiliary Field

Plate 3 Groundwater Sampling Locations and Groundwater Contours, Wendover Air Force Auxiliary Field

Plate 4 Impacts to Soil and Groundwater, Wendover Air Force Auxiliary Field

LIST OF APPENDICES

Volume II

APPENDIX A: MASTER SAMPLE LOG

A.1 Sorted by Sample Identification Number
A.2 Sorted by Matrix Type

APPENDIX B: PERSONNEL INTERVIEW SUMMARIES

B.1 Wendover Air Force Auxiliary Field
B.2 Hill Air Force Range

APPENDIX C: REPORT OF CONE PENETROMETER TESTING

Volume III

APPENDIX D: REPORT OF FIELD GAS CHROMATOGRAPHY SERVICES

APPENDIX E: ANALYTICAL RESULTS

E.1 Soil Analytical Results
E.2 Groundwater Analytical Results

APPENDIX F: PROJECT QUALITY ASSURANCE/QUALITY CONTROL SUMMARY

APPENDIX G: GEOTECHNICAL LABORATORY SOIL TEST RESULTS

APPENDIX H: FIELD LOGS AND FORMS

H.1 Lithologic and Well Completion Logs
H.2 Well Development Forms
H.3 Water Level Survey Data

APPENDIX I: SURVEY DATA FOR MONITOR WELLS AND CONE PENETROMETER TESTING LOCATIONS

APPENDIX J: ANALYTICAL DATA USED IN SITE SCORING

LIST OF APPENDICES
(CONTINUED)

Volume IV

APPENDIX K: SITE SCORING INFORMATION

- K.1 Hazard Ranking System Scoresheets and Waste Quantity Calculations for Wendover Air Force Auxiliary Field
- K.2 Hazard Ranking System Scoresheets and Waste Quantity Calculations for Hill Air Force Range

APPENDIX L: WATER RIGHTS INFORMATION

- L.1 Wendover Air Force Auxiliary Field
- L.2 Hill Air Force Range

SUMMARY OF FINDINGS

A preliminary assessment/site investigation (PA/SI) was performed at the Wendover Air Force Auxiliary Field (AFAF) and a PA was performed at the Hill Air Force Range (HAFR). The PA/SI was performed to gather sufficient information to allow Hazard Ranking System (HRS) scoring of sites at Wendover AFAF and the HAFR as a whole. This document presents the results, conclusions, and recommendations of the PA/SI. The wastes, contaminants of potential concern, and description or current status of each of the sites evaluated at Wendover AFAF and the HAFR are summarized in Tables 1 and 2, respectively.

Site investigation activities, which included the collection of environmental samples, were conducted only at Wendover AFAF. A conceptual site model illustrating some of the types of contaminant sources and potential exposure routes at Wendover AFAF is presented in Figure 1. The locations of the sites investigated at Wendover AFAF are shown in Figure 2.

HRS scores were calculated for each of the 18 sites investigated at Wendover AFAF and for the HAFR as a whole. The objective of HRS scoring was to evaluate each site's potential for hazardous substance releases to cause health or safety problems, or ecological or environmental damage. All site scores are well below 28.5, which is typically the score that, if exceeded, indicates that a site warrants further action.

History and Land Use

The HAFR has been used continuously for bombing and gunnery practice for military aircraft since 1940. The land is owned by the Department of Defense (DOD). Prior to 1940, the land now occupied by the HAFR accommodated sparse cattle and sheep herding activities. The land surrounding the HAFR, the vast majority of which is owned by the Department of the Interior (Bureau of Land Management), is still used for sparse cattle and sheep herding.

Wendover Air Force Base (AFB) and the HAFR were established in 1940 when the Air Corps initiated a massive expansion program. From this beginning, Wendover AFB and the HAFR grew until, at its height, they together encompassed 3.5 million acres and represented the largest military reserve in the world.

The basic mission of Wendover AFB and the HAFR during World War II was to train heavy bombardment groups. All the necessary operational support facilities were constructed at the Base. Some of the past support facilities were identified during the PA/SI as potential sources of contamination. These include the landfill, salvage yard, maintenance shops, fire station, fire training pit, sewage treatment plant, power plant, and gasoline stations.

In the spring of 1945, the training program slowed to a standstill, and activity was shifted to the development of weapons. The Base's assignment included the testing and development of various types of missiles.

In December 1960, the Base was placed on inactive caretaker status, under the management of Hill Air Force Base. The Base was then reactivated in July 1961 as the Wendover Air Force Auxiliary Field. Portions of the Base were turned over to the town of Wendover in 1977.

Currently, there are approximately 110 remaining military-built structures at Wendover AFAF. Individual building conditions vary from structurally sound to very deteriorated. Approximately 30 of the remaining buildings are being used by a variety of tenants for private or public use. Most of the original hangars and other buildings adjacent to the apron area still exist. There are six remaining hangars: three are currently used for private aircraft storage and the other three are currently vacant and in deteriorated condition.

The primary use of the land by the military is for a radar tracking and search facility. Other

Table 1

Summary of Sites Evaluated
Wendover Air Force Auxiliary Field

Site Number	Site Name	Period of Operation	Wastes Potentially Released	Contaminants of Potential Concern	Current Status
K	Landfill	1940 - 1982	Construction rubble, plating mill wastes, spent solvents, and fuels	Metals, asbestos, volatile organic compounds, and petroleum hydrocarbons	No longer used
V	V-1 Rocket Launching Site	Early 1940s - Late 1940s	Fuels	Petroleum hydrocarbons	No longer used
E	Post Salvage Yard	1940 - 1960	Construction rubble, plating mill wastes, spent solvents, and fuels	Metals, asbestos, volatile organic compounds, and petroleum hydrocarbons	No longer used
W	Sewage Treatment Plant	1940 - 1960	Sewage effluent	Petroleum hydrocarbons, volatile organic compounds, metals, and polychlorinated biphenyls	No longer used
P	Hangar 1/Machine Shop	1940 - 1947	Plating mill wastes, spent solvents, and fuels	Metals, volatile organic compounds, and petroleum hydrocarbons	Building burned down in 1947
L	West Aircraft Drainage Ditch to Blue Lake	1940 - 1960	Fuels, waste oil, spent solvents, and transformer oil	Petroleum hydrocarbons, volatile organic compounds, and polychlorinated biphenyls	No longer used for waste disposal
B	Engineer Motor Pool Sump Box	1940 - 1960	Fuels, waste oil, and spent solvents	Petroleum hydrocarbons and volatile organic compounds	No longer used, building removed
BB	Atomic Warhead Storage Bldg	1944 - 1945	Fuels and waste oil	Petroleum hydrocarbons	Building now used to store petroleum products
Q	Automotive Fuel Depot	1940 - 1960	Fuels, waste oil, and spent solvents	Petroleum hydrocarbons and volatile organic compounds	No longer used, building removed
M	2600 Area Buildings	Late 1950s - Early 1970s	Solvents and transformer oil	Volatile organic compounds and polychlorinated biphenyls	Buildings used for general storage

Table 1

(Continued)

Site Number	Site Name	Period of Operation	Wastes Potentially Released	Contaminants of Potential Concern	Current Status
D	Old Fire Station Ditch	1940 - Present	Fuels, waste oil, spent solvents and transformer oil	Petroleum hydrocarbons, volatile organic compounds, and polychlorinated biphenyls	No longer used
G	Hospital Area (cradle tanks)	1940 - 1960	Heating oil	Petroleum hydrocarbons	No longer used, buildings/tanks removed
R	Secondary Auto Fuel Shop	1940 - 1960	Fuels, waste oil, and spent solvents	Petroleum hydrocarbons and volatile organic compounds	No longer used, building removed
S	Fuel Dispensing Station	Early 1940s - Late 1940s	Fuels, waste oil, and spent solvents	Petroleum hydrocarbons and volatile organic compounds	Tanks removed in early 1950s
F	Fire Drill Pit	1940 - 1960	Fuels, spent solvents and transformer oil	Petroleum hydrocarbons, volatile organic compounds, and polychlorinated biphenyls	No longer used, built over by buildings and roads
O	Paint Disposal Pit	1940 - Late 1950s	Paints and spent solvents	Metals and volatile organic compounds	No longer used
OO	*Paint Disposal Pit II*	1940 - Late 1950s	Paints and spent solvents	Metals and volatile organic compounds	No longer used
Z	Apron Area	1940 - Present	Fuels, waste oil, spent solvents, transformer oil, and plating mill wastes	Petroleum hydrocarbons, volatile organic compounds, polychlorinated biphenyls, and metals	Area used by Town of Wendover; various businesses
20	Ordnance Disposal Areas (4 miles SW of Wendover)	1940 - 1960	Propellants and waste ordnance	Hydrazine, ammonium perchlorate, metals, TNT, DNT, RDX, HMX, and depleted uranium	No longer used

Source: Personnel interviews and previous investigations (ETC,1992).

Table 2

Summary of Sites Identified
Hill Air Force Range

SWMU* Number	Site Name	Location	Period of Operation	Description	Wastes/Contaminants of Potential Concern
1	Landfill	West side of ridge south of Checkpoint Charlie	1980s	Spent munitions debris	Scrap metal
2	Landfill	CBU Valley	1980s	Pit with 5-10k of 20 mm rounds from test	Munitions/scrap metal
3	Spill	Eagle Tower	1992	Heating oil spill	Heating oil
4	Underground Injection Point	Eagle Tower	1972 - Present	Oil/water separator and drain field for floor drains in maintenance building	Oil and grease
5	Landfill	NE of main compound	1969 - Present	Dry landfill for oasis compound	Garbage
6	Landfill	NE of main compound	1975 - Present	Wet landfill for oasis compound	Kitchen waste
7	Landfill	Landfill 5	1975 - 1985	Former sludge disposal pit	IWTP sludge
8	LBDF	NW of compound	1984 - Present	Lithium battery disposal facility	Active TSDF
9	TTU-Residuals Pits	4.5 miles NE of compound	1950s - 1991	4-acre disposal site for scrap metal from TTU operations	Waste munitions and propellants
10	TTU-Disposal Pit	4.5 miles NE of compound	1950s - Present	1-acre active trench used for open burning (Site 3)	Waste munitions and propellants
11	TTU-Operations Area	4.5 miles NE of compound	1989 - Present	Site 1, Site 2, and Site 3 at the TTU	Waste munitions and propellants
12	Chem Pit 4	3 miles N of compound	1970s	200 X 200 ft. landfill area	Waste oils
13	Sewage Lagoon	NW of compound	1968 - Present	Active sewage lagoon for oasis compound	Domestic wastewater
14	Fire Training Area	NW of compound	1975 - Present	Active fire training range	Fuels
15	MWR Yard	Main compound	1980 - Present	Area used to prepare old vehicles to be used as targets on the range	Fuels/oils spilled on ground
16	Target Yard	Main compound	1980 - Present	Area used to prepare old vehicles to be used as targets on the range	Fuels/oils spilled on ground
17	Landfill	N end CBU Valley	1980s	Landfill for construction debris from test	Metal/concrete scrap from tests

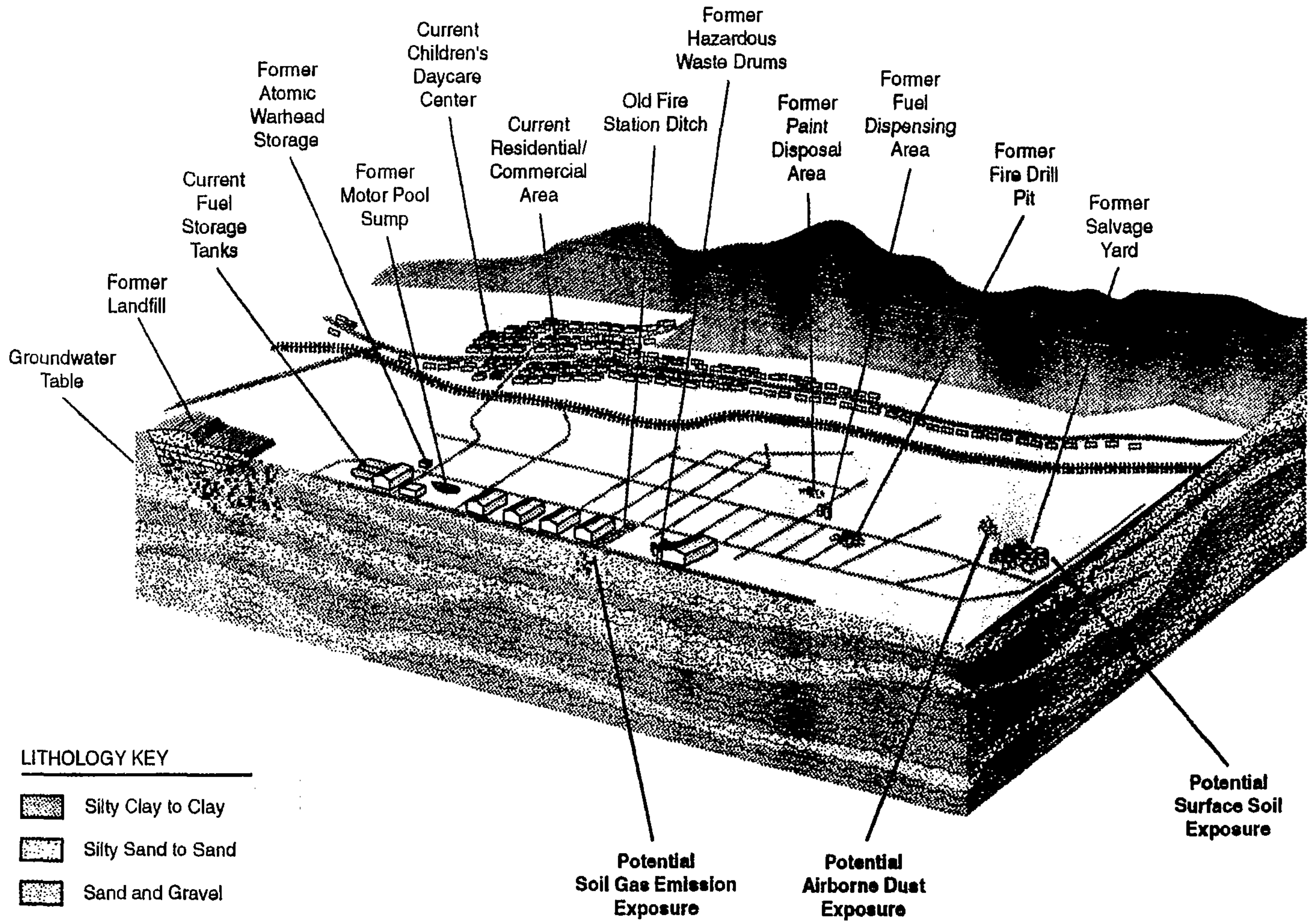
Table 2

(Continued)

SWMU[a] Number	Site Name	Location	Period of Operation	Description	Wastes/Contaminants of Potential Concern
18	Landfill	N end CBU Valley	1980s	Landfill for construction debris from test	Metal/concrete scrap from tests
19	HW Accumulation Point-LM 34	SW area Bldg 6006	1991 - Present	Satellite accumulation site	Vacuum system water/propellant waste
20	HW Accumulation Point- TE-05	East side of Bldg 10018	1991 - 1993	Satellite accumulation site	Battery acid
21	HW Accumulation Point-TE-06	East side of Bldg 10018	1991 - Present	Satellite accumulation site/waste oil site	Used antifreeze and waste oil
22	HW Accumulation Point-TW-04	MWR target compound, east side of Admin Bldg	1991 - Present	Satellite accumulation site/waste oil site	Off specification waste oil
23	HW Accumulation Point-TU-02	South side of Bldg	1991 - Present	Satellite accumulation site	Used antifreeze and waste oil
24	HW Accumulation Point-TU-03	UST NW corner Bldg 40065	1991 - Present	Used oil site	Used oil
25	HW Accumulation Point-TU-05	SW of Bldg 4001	1991 - Present	Nonsatellite site. Collection point for sites TM-04, TE-05, TE-06, TU-02, and TU-03	Off specification waste oil, used antifreeze and paint remnants

Source: Interviews of HAFR personnel.

[a]Solid waste management unit.



WEND12.FH3 - VMG 2/8/94 SAC

Figure 1. Conceptual Site Model - Wendover Air Force Auxiliary Field

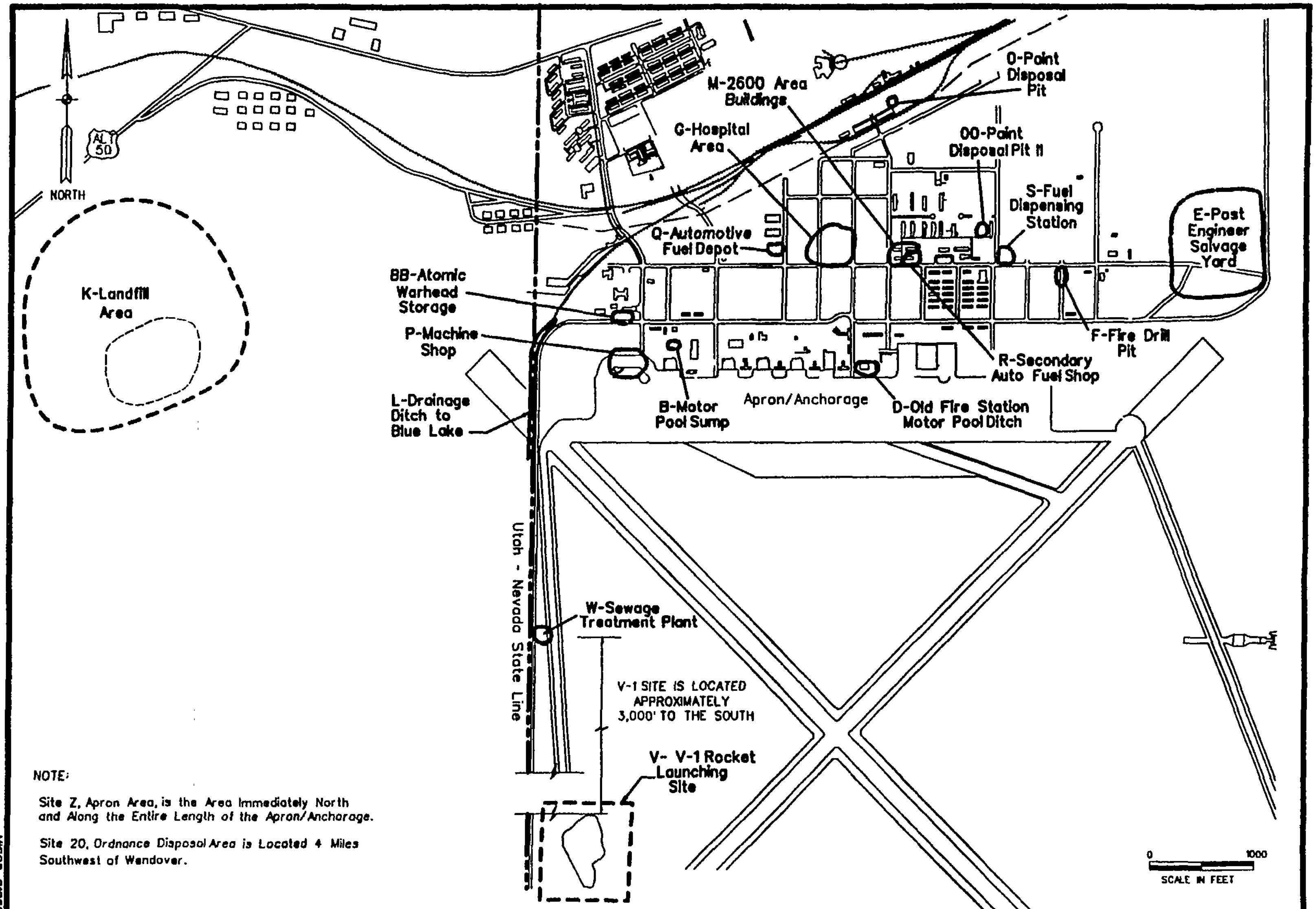


Figure 2. Delineation of Sites, Wendover Air Force Auxiliary Field

military training exercises are conducted periodically. Some of the land and old buildings now owned by the town of Wendover are leased to individuals for residential and commercial purposes. Other small parcels of land are privately owned. There are approximately 15 residents and about 30 employees of various businesses and for the town of Wendover on the Base. The town owns the airport, which accommodates various private aircraft and one daily commercial flight that brings tourists in to visit the local casinos.

The landfill was used jointly by the military, the town of Wendover, and Elko County, Nevada, between the years 1940 to 1975. Operation of the landfill was turned over to the town and Elko County in 1977. Its use continued until about 1982, when another landfill was established in a different location. The land occupied by the former landfill was withdrawn from public use by DOD in 1942 under Public Land Order 50.

The city of West Wendover, Nevada, is pursuing plans that have not been approved to develop a 1400-acre airport industrial park with its own airport taxi ways, rail spurs, and highway access. West Wendover hopes to acquire 1400 acres from within the old landfill area from the Bureau of Land Management (BLM). The proposed industrial park would be located immediately west of the current airport. The proposed development would accommodate general commercial and industrial tenants.

Site Investigation

Information obtained during the personnel interviews and from previous investigations concerning potential contaminant sources, wastes generated, and waste management practices was used to prioritize the sites at Wendover AFAF for investigation. Sites that are designated with alphabetical characters (e.g., Site K) were identified during the personnel interviews. At the HAFR, all sites were identified as a result of the personnel interviews. No site investigation activities were conducted at the HAFR.

On the basis of the results of the site investigation, the area appearing to be most negatively impacted by past activities at Wendover AFAF is the area extending between Site E to Site L and generally between A Street and the aircraft apron. The maximum concentrations of contaminants detected in both soil and groundwater are presented in Table 3. In general, the sites appearing to be most negatively impacted by both soil and groundwater contamination are Sites D, E, F, L, M, P, and Z.

Background chemical concentrations for neither soil or groundwater were determined during the site investigation. This was because of the location of the Wendover AFAF with respect to other numerous potential contaminant sources as well as changes in soil types, geology, and hydrostratigraphic conditions immediately north (upgradient) of the Base. Efforts were made to sample groundwater and soils in upgradient areas or areas believed to be relatively unaffected by past activities at the Base.

Groundwater--Field screening of groundwater samples collected during cone penetrometer testing (CPT) activities detected the presence of acetone, benzene, chloroform, ethylbenzene, tetrachloroethylene, trichloroethylene, toluene, methylene chloride, and additional unknown volatile organic compounds (VOCs). The concentrations detected ranged from 0.01 to 8.4 parts per million (ppm).

The sites with the highest, intermediate, and lowest relative concentrations of VOCs detected by field screening groundwater during CPT activities at Wendover AFAF are categorized below.

- Sites BB, E, F, L, P, and Z: High VOC concentrations (>1 ppm);
- Sites D, G, K, M, and O: Intermediate VOC concentrations (<1 and >0.09 ppm);
- Sites B, Q, R, S, and W: Lowest VOC concentrations (<0.09 ppm); and
- Site V: No VOCs detected.

The sites with the highest and intermediate VOC concentrations were chosen for groundwater

Table 3

Maximum Concentrations of Contaminants Exceeding Regulatory Criteria
Wendover Air Force Auxiliary Field

Organic Contaminants	Soil				Groundwater			
	RCRA Subpart S Action Level (mg/kg)	Maximum Concentration Detected in Soil* (mg/kg)	Site Containing Maximum Concentration	Number of Additional Exceedances	Utah DEQ Maximum Contaminant Level (µg/L)	Maximum Concentration Detected in Groundwater* (µg/L)	Site Containing Maximum Concentration	Number of Additional Exceedances
Volatile Organic Compounds								
Benzene	---	---	---	---	5	204	Z	0
1,2-Dichloroethane	---	---	---	---	5	8.02	M	1
Semivolatile Organic Compounds								
Benzo(a)pyrene	0.09589	0.345	Z	1	---	---	---	---
Benzo(b)fluoranthene	0.07	0.957	Z	0	---	---	---	---
Pesticides								
Aldrin	0.041176	0.0486	Z	0	---	---	---	---
Dieldrin	0.04375	0.149	O	1	---	---	---	---
Heptachlor	---	---	---	---	0.4	1.01 K	Z	2
Heptachlor Epoxide	---	---	---	---	0.2	284 K	F	4

Table 3

(Continued)

Inorganic Contaminants	Soil				Groundwater			
	RCRA Subpart S Action Level (mg/kg)	Maximum Concentration Detected in Soil[a] (mg/kg)	Site Containing Maximum Concentration	Number of Additional Exceedances	Utah DEQ Maximum Contaminant Level (μg/L)	Maximum Concentration Detected in Groundwater[b] (μg/L)	Site Containing Maximum Concentration	Number of Additional Exceedances
Arsenic	0.4	23	Z	44	---	---	---	---
Antimony	---	---	---	---	0.006	0.0184 BJ	Z	2
Beryllium	0.162791	0.566	BB	34	---	---	---	---
Lead	---	---	---	---	0.05	2.37 B	Z	2
Selenium	---	---	---	---	0.01	0.078	E	1
Thallium	---	---	---	---	0.002	0.0394 B	Z	9

B Result may be biased high. Analyte was detected in method blank.

J Result is less than stated Detection Limit but greater than or equal to specified Reporting Limit.

K Both the identity and concentration of this compound were not confirmed because the compound was not detected on the secondary column.

[a]Maximum concentrations exceeding proposed RCRA Subpart S action levels (U.S. Environmental Protection Agency, 55 Federal Register 30798-30884, 27 July 1990).

[b]Maximum concentrations exceeding State of Utah, Division of Environmental Quality or Federal Drinking Water Maximum Contaminant Levels.

monitoring. The only exception was Site G, where landowner approval to install a well was not obtained. In its place, a monitor well was installed at Site W.

Organic contaminants were detected in groundwater samples collected from all 17 monitor wells installed during the PA/SI at Wendover AFAF, including the designated upgradient well. Organic contaminant concentrations exceeding established regulatory maximum contaminant levels (MCLs), however, were detected in less than half of the 17 monitor wells. Organic contaminants (1,2-Dichloroethane, benzene, heptachlor, and heptachlor epoxide)-exceeding the established MCLs were detected at Sites D, E, F, M, and Z. It should be noted, however, that both the identification and concentrations of heptachlor were not confirmed. This is because it was not detected on the secondary column during laboratory analysis.

Inorganic constituents exceeding MCLs were detected in the groundwater in 12 of the 17 wells. Lead, selenium, antimony, and thallium were the only inorganic compounds detected in groundwater at concentrations exceeding MCLs. One or more inorganic constituent was detected at a concentration exceeding the MCL at Sites D, E, F, K, M, O, and Z. It should be noted, however, the analytical results of the inorganic constituents may be biased high. This is because an analyte was detected in the method blank of the majority of samples analyzed.

The direction of groundwater flow beneath Wendover AFAF varies, but flows generally to the south-southeast. Anomalously low groundwater elevations were measured in the vicinity of Site BB. It is believed that groundwater may be transmitted from the overlying sediments into the deeper, more permeable fractured bedrock in this area.

Soils--Contaminant concentrations detected in soils during the PA/SI were compared with the proposed RCRA Subpart S action levels. The proposed action levels were used for comparison purposes only and are not intended for use as regulatory cleanup standards or as criteria for further investigation of soil contamination. Surface and subsurface soils were found to contain six contaminants (four organic and two inorganic) at concentrations exceeding the proposed action levels.

Organic contaminant concentrations exceeding proposed action levels were detected at Sites L, O, and Z. The organic contaminants detected in soils were limited to organochlorine pesticides (aldrin and dieldrin), and semivolatile organic compounds (benzo(a)pyrene and benzo(b)fluoranthene). The identity and concentration of dieldrin were not confirmed, however, because it was not detected on the secondary column during laboratory analysis.

Arsenic and beryllium were the only inorganic compounds detected in soils at concentrations exceeding the proposed action levels at 45 of the 46 locations sampled. Arsenic was detected at concentrations exceeding the proposed action levels at Sites BB, D, E, F, K, L, O, OO, P, W, and Z. Beryllium was detected in soils at concentrations exceeding the action level at all of these sites, with the exception of Site F. Arsenic and beryllium were detected at 98 percent of the locations sampled, including locations E-104 and E-105 that were thought to be unaffected by contamination. It is likely that the concentrations of arsenic and beryllium that were detected occur naturally in the soils.

The soil units observed during monitor well borehole drilling consist of upper, middle, and lower silty sands and silty clays. Typically, the silty sands are light gray, fine grained, poorly graded, and wet (the upper sand is dry to moist). The silty clay units are light olive-gray, very soft to firm, plastic, and wet. Permeabilities for all lithologies tested from the screened interval of the monitor well borings were determined to range between 1.1×10^{-3} and 8.3×10^{-8} cm/sec.

Site Scoring

The HRS scores are based on an evaluation of groundwater migration, surface water migration, soil exposure, and air migration pathways that could potentially expose human, environmental, and resource receptors to contamination. The conclusions and recommendations along with the HRS scores for the sites evaluated are presented in Table 4.

Table 4

Conclusions and Recommendations for Sites Evaluated Wendover Air Force Auxiliary Field

Facility	Site Number	Site Name	Laboratory Analysis of Soil and/or Groundwater Samples	Contaminants Detected in Groundwater Exceeding Utah MCLs[a]	Contaminants Detected in Soil Exceeding RCRA Subpart S Action Levels[b]	HRS Score	Recommendations[c]
Wendover AFAF	K	Landfill	Yes	Thallium	Arsenic and beryllium	0.61	No further action
	V	V-1 Rocket Launching Site	No	None[d]	Not sampled	0.00	No further action
	E	Post Salvage Yard	Yes	Heptachlor, selenium, antimony, and thallium	Arsenic and beryllium	0.21	No further action
	W	Sewage Treatment Plant	Yes	None[d]	Arsenic and beryllium	0.47	No further action
	P	Hanger 1/Machine Shop	Yes	Trichloroethelyene[d]	Arsenic and beryllium	0 .31	No further action
	L	West Aircraft Drainage Ditch to Blue Lake	Yes	Trichloroethylene[d], benzene[d], and tetrachloroethylene[d]	Benzo(a)pyrene, arsenic, and beryllium	0.60	No further action
	B	Engineer Motor Pool Sump Box	No	None[d]	Not sampled	0.16	No further action
	BB	Atomic Warhead Storage Bldg	Yes	Ethylbenzene[d] and trichloroethylene[d]	Arsenic and beryllium	0.77	No further action
	Q	Automotive Fuel Depot	No	None[d]	Not sampled	0.39	No further action
	M	2600 Area Buildings	Yes	1,2-Dichloroethane, heptachlor epoxide, thallium, and benzene[d]	None	0.62	No further action
	D	Old Fire Station Ditch	Yes	1,2-Dichloroethane, heptachlor epoxide, lead, benzene[d], chloroform[d], and trichloroethylene[d]	Arsenic and beryllium	5.13	No further action
	G	Hospital Area (cradle tanks)	No	Benzene[d]	Not sampled	0.52	No further action
	R	Secondary Auto Fuel Shop	No	Trichloroethylene[d]	Not sampled	0.19	No further action

Table 4

(Continued)

Facility	Site Number	Site Name	Laboratory Analysis of Soil and/or Groundwater Samples	Contaminants Detected in Groundwater Exceeding Utah MCLs[a]	Contaminants Detected in Soil Exceeding RCRA Subpart S Action Levels[b]	HRS Score	Recommendations[c]
Wendover AFAF (continued)	S	Fuel Dispensing Station	No	Chloroform[d] and trichloroethylene[d]	Not sampled	0.16	No further action
	F	Fire Drill Pit	Yes	Heptachlor epoxide, thallium, benzene[d], and chloroform[d]	Arsenic	0.58	No further action
	O	Paint Disposal Pit	Yes	Thallium and benzene[d]	Dieldrin, arsenic, and beryllium	0.90	No further action
	OO	Paint Disposal Pit II	Yes	Not sampled	Arsenic and beryllium	0.52	No further action
	Z	Apron Area	Yes	Benzene, heptachlor, heptachlor epoxide, lead, antimony, thallium, chloroform[d], and trichloroethylene[d]	Aldrin, beno(a)pyrene, benzo(b)fluoranthene, arsenic, and beryllium	3.94	No further action
	20	Ordnance Disposal Areas	No	Not sampled	Not sampled	Not scored	No further action
UTTR	NA	UTTR	No	Not sampled	Not sampled	14	No further action

NA Not applicable.

[a]State of Utah, Division of Environmental Quality or Federal Drinking Water Maximum Contaminant Level (MCLs). Site K, located in the State of Nevada, should be compared to Nevada MCLs; however, Nevada MCLs are no more stringent than either the Utah or Federal MCLs.

[b]U.S. Environmental Protection Agency, 55 Federal Register 30798-30884, 27 July 1990.

[c]Based on site scores. Generally, sites that score 28.5 or greater receive a "further action" recommendation.

[d]Based on field gas chromatograph screening of groundwater samples for volatile organic compounds during cone penetrometer testing activities.

Several factors combined have resulted in low scores for the sites. These include the generally low potential for exposure to contamination and the general lack of human, environmental, and resource exposure receptors. In addition, the lack of surface water and groundwater use were major factors in scoring Wendover AFAF sites.

The potential for exposure through the groundwater pathway near Wendover AFAF is nonexistent, and this pathway was not scored. Groundwater is not used for drinking or as a resource in the vicinity of Wendover AFAF. At the HAFR, the potential for exposure through the groundwater pathway is expected to be moderate. Groundwater is used to supply water for domestic needs, including drinking, for the 87 people who live and work on the facility. In addition, groundwater is used for stock watering, irrigation, and other uses within 4 miles of the facility. There are no wellhead protection zones near Wendover AFAF or the HAFR.

The potential for exposure through the surface water pathway at Wendover AFAF is expected to be nonexistent, and this pathway was not scored. Surface water in the area of Wendover AFAF and the HAFR does not occur in permanent, naturally occurring streams. Surface drainages would contain water only during brief episodes following snow melt and storm events. Surface water does occur near Wendover AFAF in evaporation ponds used to commercially recover potash. The water in these ponds does not supply drinking water and does not support human food chain organisms.

At the HAFR, the potential for exposure through the surface water pathway is expected to be minimal. Although surface water from contaminated sites at the HAFR could ultimately discharge to the Great Salt Lake, the Lake does not supply drinking water and does not support human food chain organisms. There are some intermittent streams that supply water for livestock outside the boundaries of the HAFR; however, these are not expected to receive runoff from the HAFR contaminated sites.

The likelihood of exposure through the soil pathway is expected to be moderate to high. Evaluation of the soil pathway assumes direct contact with hazardous substances by human, environmental, and resource receptors. Many portions of Wendover AFAF are accessible to the general public, whereas exposure through the soil pathway at the HAFR would be limited to on-site workers since it is a military facility not generally accessible to the public.

Potential exposure through the air migration pathway may occur for receptors at Wendover AFAF and the HAFR. For Wendover AFAF, a softball field located in the town of Wendover and Danger Cave State Park and Historical Monument are a resource and a sensitive environment, respectively, that may be potentially impacted by hazardous substances found at the sites. At the HAFR, there are no known sensitive environments or resources located within 4 miles of the site. Thus, the likelihood of exposure through the air pathway at the HAFR would be expected to occur only to on-site workers and residents.

Recommendations

On the basis of the HRS scores of the sites evaluated during the PA/SI, no further investigation associated with any specific site is recommended. All site scores are well below 28.5, which is typically the score that, if exceeded, indicates a site warrants further action.

No further investigation of potential soil contamination associated with any specific site at Wendover AFAF is recommended. The proposed action levels were used for comparison purposes only and are not intended for use as regulatory cleanup standards or as the criteria for further investigation of soil contamination. Further investigation is recommended; however, to establish whether or not the concentrations of arsenic and beryllium detected in soils throughout Wendover AFAF are naturally occurring.

No further investigation of groundwater quality is recommended in the vicinity of Wendover AFAF. Groundwater is not used for drinking and the potential for exposure through the groundwater pathway is nonexistent.

Civilian access to the majority of Wendover AFAF is unrestricted and disturbance of soils or groundwater could result in human exposure to hazardous substances. It is recommended that any future development or construction-related activities that may either disturb the soil or result in contact with groundwater at Wendover AFAF proceed with caution. Appropriate environmental and health and safety controls should be used to monitor and minimize potential human exposure to hazardous substances during development activities. Remedial investigations may be warranted to develop exposure controls or remedial strategies in areas planned for future development. Alternatively, development restrictions through appropriate zoning controls could be used to prevent potential exposure to hazardous substances.

Measures to address potential exposure to hazardous substances at Wendover AFAF are particularly recommended for any development activities that may occur in the vicinity of Sites D, E, F, L, M, P, and Z. These sites were identified during the site investigation as being the most contaminated. This recommendation also extends to any possible future development or construction activities associated with the 1400-acre industrial park proposed in an area that includes the old landfill.

On the basis of the HRS score of 14, no further investigation is recommended for the north range of the HAFR. It is recommended, however, that the U.S. Air Force continue its search, inventory, and characterization of solid waste management units (SWMUs) at the north range of the HAFR. This search and inventory of SWMUs at the HAFR is an ongoing activity of the U.S. Air Force and is being conducted under the jurisdiction of the Resource Conservation and Recovery Act.

Section 1
INTRODUCTION

The purpose of this document is to present the results, conclusions, and recommendations of the preliminary assessment/site investigation (PA/SI) of the Wendover Air Force Auxiliary Field (AFAF) and the PA of the Hill Air Force Range (HAFR). Figure 1-1 shows the locations of Wendover AFAF and the HAFR. Figures 1-2 and 1-3 show the layout of each of the two facilities, respectively.

The PA/SI was conducted under the U.S. Air Force Installation Restoration Program (IRP) and was performed in compliance with provisions of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended in 1986 by the Superfund Amendments and Reauthorization Act (SARA). The U.S. Environmental Protection Agency (EPA) CERCLIS identification number for the HAFR is UT0570090001.

Site investigation activities, which included the collection of environmental samples, were conducted only at Wendover AFAF. Sites classified as either formerly used defense sites (FUDS) or underground storage tank (UST) sites where the tanks were believed to be still in the ground were not included as part of the scope of the PA/SI. These sites will be addressed at a future date under their respective programs.

Assessment of the HAFR included only personnel interviews and searches for previous investigations and records because of the size of the area and the potential presence of unexploded ordnance. The methods and procedures utilized during the PA/SI are detailed in the document entitled *Final Work Plan for Preliminary Assessment/Site Investigation, Wendover Air Force Auxiliary Field and Hill Air Force Range* (Radian,1993).

1.1 Objectives

The primary objective of the PA/SI was to identify sites at Wendover AFAF and the HAFR that may require further action. This was accomplished by collecting information to allow the sites that were evaluated to be scored using the EPA Hazard Ranking System (HRS).

Sites at Wendover AFAF where quantitative analytical data were obtained during the PA/SI were scored using PREscore software, an electronic version of the HRS. The HAFR, where no site investigation activities were conducted, was scored in a more qualitative manner using PAscore, another electronic version of the HRS.

1.2 Project Approach

The PA/SI was planned in stages to ensure collection of data adequate to provide recommendations for either further action or no further action for individual sites. Further action at a site could potentially include either additional investigative activities or expedited remedial response actions. A flow diagram illustrating the approach used for the PA/SI is shown in Figure 1-4.

In conducting the PA/SI and HRS scoring, consideration was given to site characteristics, waste characteristics, migration pathways, evidence of releases, and exposure potential. The major factors considered during the PA/SI are summarized in Table 1-1.

1.3 Previous Investigations

An inventory of sites was conducted to identify potential environmental concerns at Wendover AFAF for the U.S. Army Corps of Engineers, Sacramento District by Earth Technology Corporation in August 1992. A report entitled *Defense Environmental Restoration Program Formerly Used Defense Sites, Inventory Project Report, Wendover Air Force Auxiliary Field, Tooele County, Utah* (ETC,1992) was subsequently prepared. The inventory report identified 20 sites at Wendover AFAF and categorized the sites by potential hazards. The majority of the sites were classified as eligible for FUDS funding, whereas a small number were deemed ineligible because of non-Department of Defense (DOD) beneficial use or current DOD property ownership.

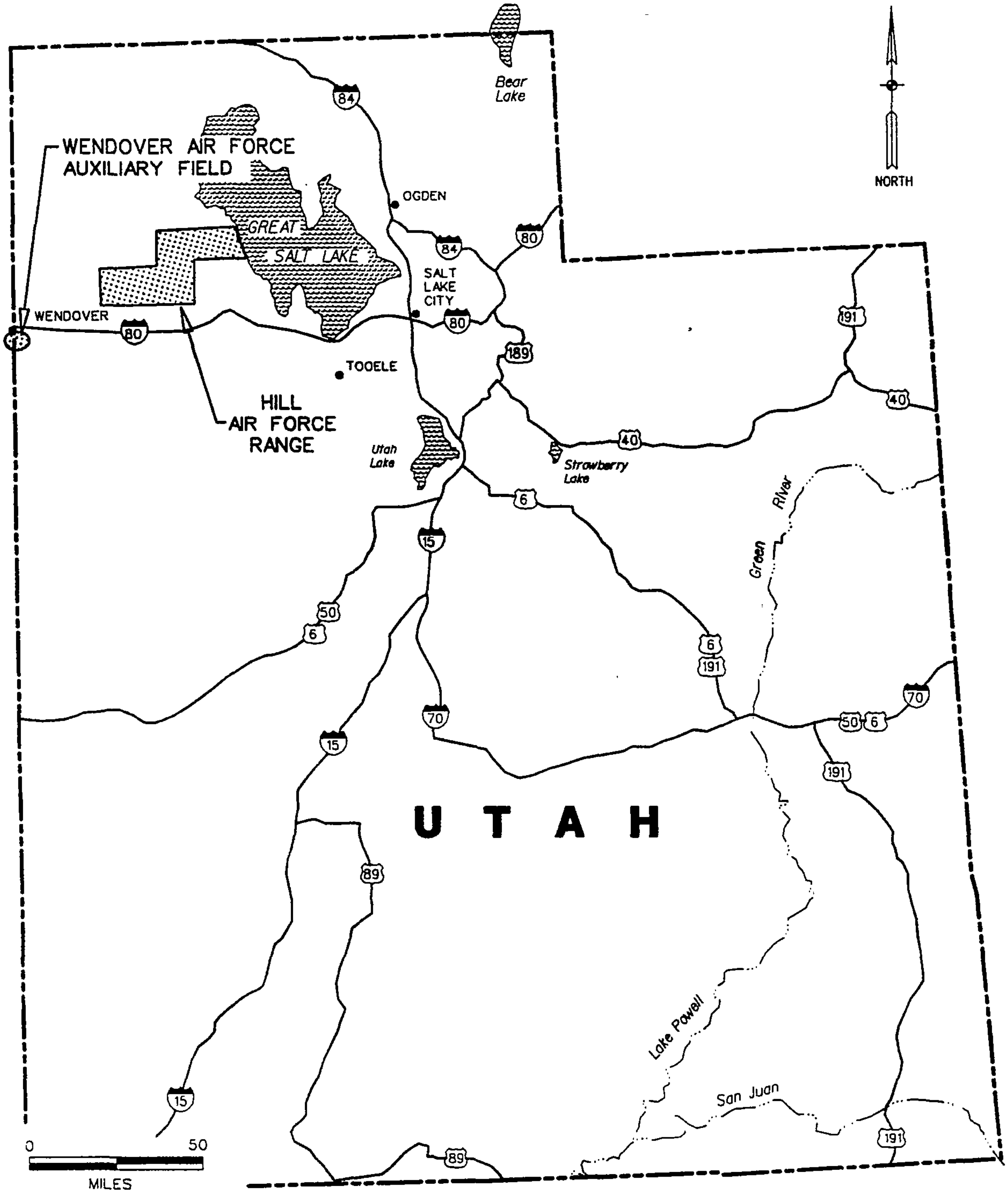


Figure 1-1. Location of Wendover Air Force Auxiliary Field and Hill Air Force Range

MISC10 G10623 SAC VRL

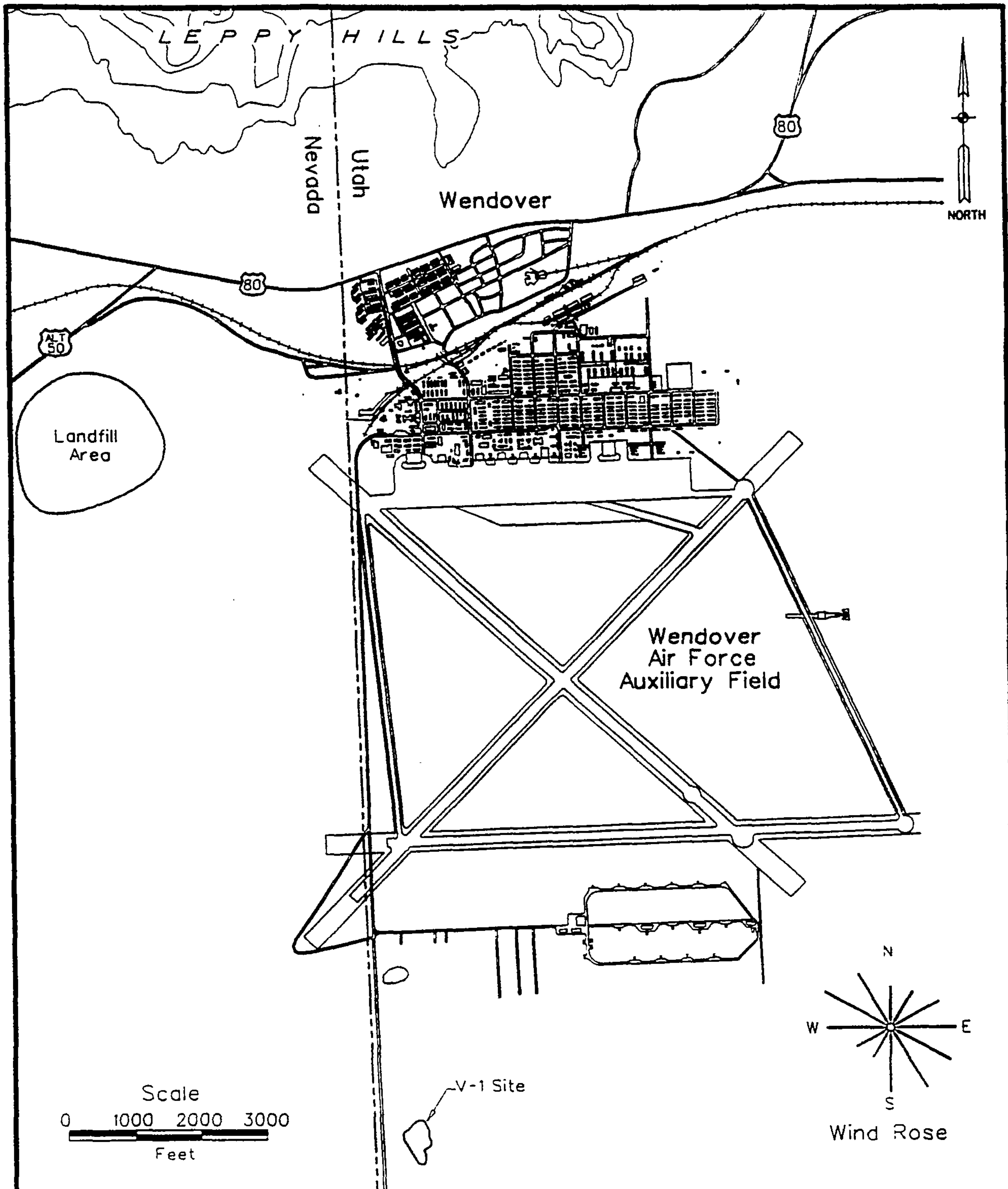


Figure 1-2. Site Map of Wendover Air Force Auxiliary Field, Utah and Nevada

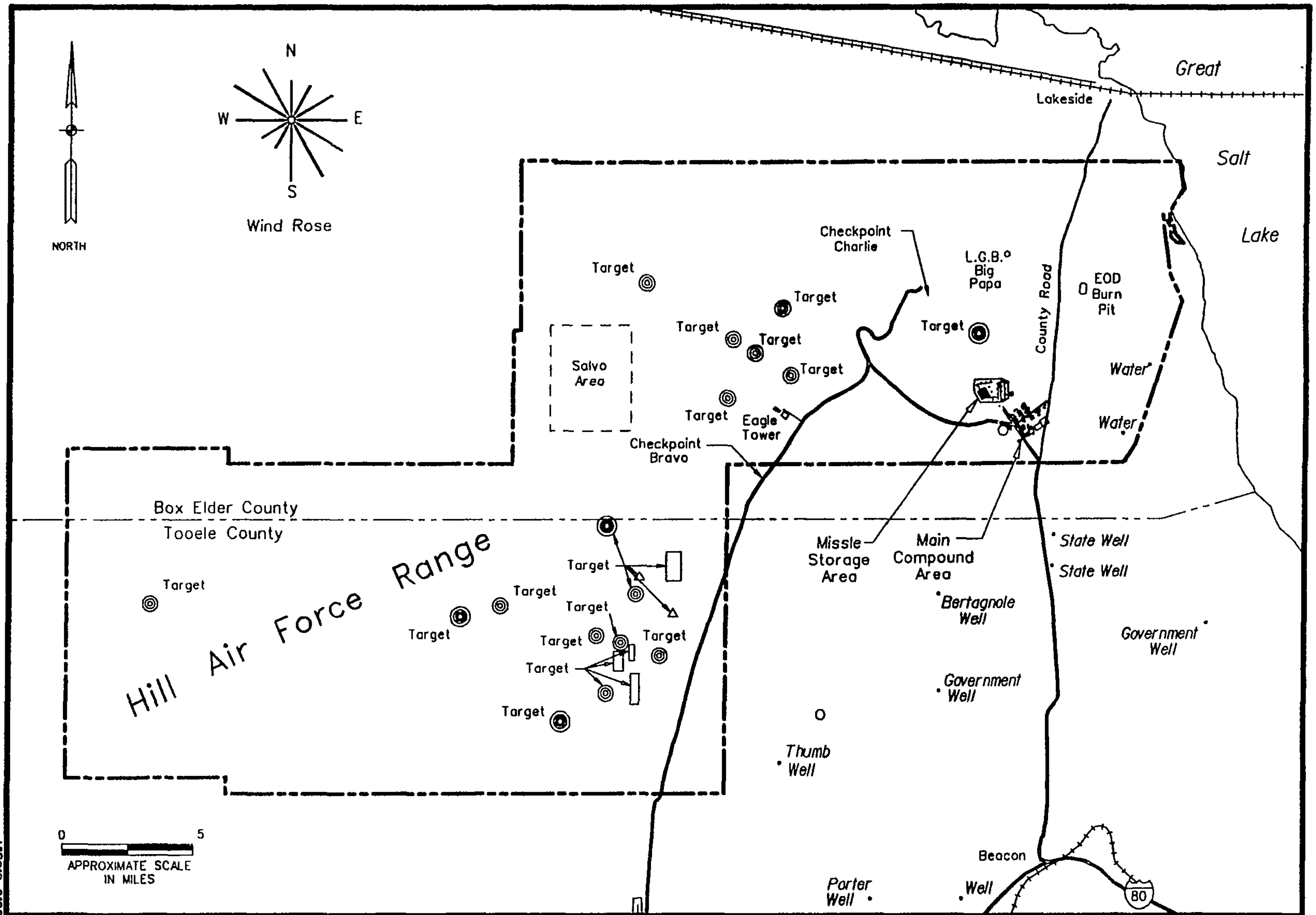


Figure 1-3. Site Map of Hill Air Force Range

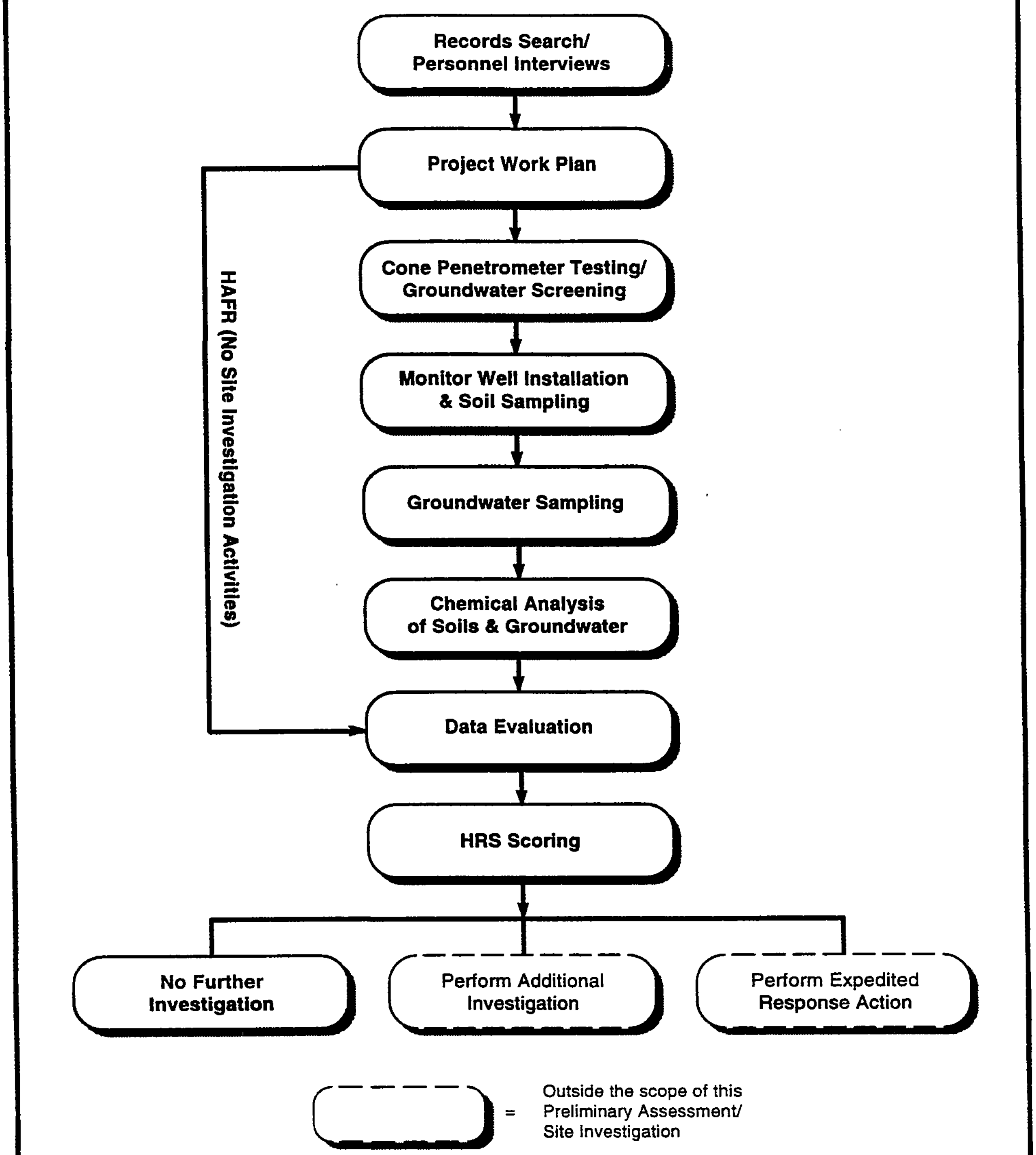


Figure 1-4. Project Approach for Preliminary Assessment/Site Investigation, Wendover Air Force Auxiliary Field and Hill Air Force Range

WEND12.PM4 - VMG 2/18/94 SAC 1

Table 1-1

Major Factors Considered During Preliminary Assessment/Site Investigation, Wendover Air Force Auxiliary Field and Hill Air Force Range

Site Characteristics	Waste Characteristics	Migration Pathways	Evidence of Release	Exposure Potential
Type of site Formerly Used Defense Site Underground storage tank site Design features Operating practices (past and present) Period of operation Age of site Location of site General physical conditions	Type of waste placed in the site Migration and dispersal characteristics of the waste Toxicological characteristics Physical and chemical characteristics	Facility's geologic setting Facility's hydrogeologic setting Topographic characteristics	Prior inspection reports Citizen complaints Monitoring data Visual evidence (e.g., discolored soil, seepage, discolored surface water or runoff) Screening data	Proximity to affected population Proximity to sensitive environments Likelihood of migration to potential receptors Future use of the site

No previous investigations of Wendover AFAF have included information on chemical concentrations in environmental media. No previous investigations regarding potential environmental contamination at the HAFR are known to have been completed, with the exception of some groundwater data associated with monitor wells installed to monitor the quality of groundwater beneath Landfill No. 5 and the Thermal Treatment Unit (also known as the Explosive Ordnance Burn Pit).

1.4 Report Organization

The goal of this report is to concisely present the information obtained during the PA/SI. Figures and tables have been used to present data wherever possible. Only information gained during the course of the PA/SI is included in this report. Previous documents are referenced to provide the reader with additional sources for background information about the sites and the methods and procedures utilized during the PA/SI.

Several large removable map plates are included in the pockets at the back of this report that can be opened for reference while the document is being read. All appendices associated with this report are included as separate volumes for ease of reference.

Section 2
ENVIRONMENTAL SETTING

2.1 Site Description

2.1.1 Geographical Setting

Wendover AFAF and the HAFR are located in western and north-central Utah in the Bonneville region of the Great Basin and Range province of North America. The region consists of linear, north-trending mountain ranges separated by valleys and closed basins (Bedinger, et al., 1990). The valleys and basins consist of primarily salt flat and play a deposits of Lake Bonneville, the ancestor of the Great Salt Lake. Relief between the valleys and adjacent mountain ranges is from 3000 to 6000 ft. Runoff from the mountains drains into valleys and basins of low relief where the majority of the water evaporates or infiltrates into the basin fill sediments. Surface water drains in this area to the east toward the Great Salt Lake. Physiographic features for Wendover AFAF and the HAFR are illustrated in Figures 2-1 and 2-2, respectively.

2.1.2 Climate

The climate of Wendover AFAF and the HAFR is characterized as arid, with low annual rainfall, low relative humidity, and high evapotranspiration rates. The mean annual precipitation recorded during the period 1961 to 1990 was 5.47 in. (NOAA, 1990). Temperatures in the region can vary greatly, from below 0° F in winter and above 100° F in summer.

Winds are predominantly from the northwest or southeast, with speeds averaging 5 knots. Meteorological data for Wendover AFAF and the HAFR are presented in Table 2-1. Wind rose diagrams are included in Figures 1-2 and 1-3 for Wendover AFAF and the HAFR, respectively.

2.1.3 Surface Soils

The surface soils at Wendover AFAF and the HAFR are characterized as basin fill deposits consisting mainly of nonindurated alluvial and lacustrine sediments deposited in the ancient Lake Bonneville. The predominant soil series in the region is the Playas-Saltair complex. The Playas-Saltair soils have low permeability, are poorly drained, and strongly saline. The soil material consists of stratified lacustrine silt, clay, and sand derived from several rock sources and is on 0-1% slopes. Surface soil maps for Wendover AFAF and the HAFR are presented in Figures 2-3 and 2-4, respectively.

2.1.4 Subsurface Soils

The subsurface soils beneath Wendover AFAF and the HAFR consist of stratified lacustrine silt, clay, and sand. During the PA/SI, the subsurface soils were investigated at Wendover AFAF to a maximum depth of 67 ft using cone penetrometer testing (CPT) technology. Six distinct units were identified in the subsurface to a depth of 67 ft. The units consist of upper, middle, and lower silty sands and silty clays. Typically, the silty sands are light gray, fine grained, poorly graded, and wet (the upper sand is dry to moist). The silty clay units are light olive-gray, very soft to firm, plastic, and wet. A generalized soil column of the subsurface soils is presented in Figure 2-5.

2.1.5 Surface Water

Because of high evapotranspiration rates and low rainfall, surface water is present in Wendover AFAF and the HAFR areas only during brief episodes (depending on snow melt or occasional storms). These episodes occur primarily during the spring. During heavy rainfall, sheet flooding may originate in adjacent mountain ranges; however, the majority of the runoff infiltrates into the unconsolidated sediments before it flows onto the lake bed sediments.

Evaporation basins cover a large area in the salt flats immediately southeast of Wendover AFAF and were built where the groundwater table is near the surface. Reilly Industries, Inc., uses the evaporation basins for the commercial production of potassium chloride (potash).

2.1.6 Groundwater

The basin fill is the major hydrogeologic unit in Wendover AFAF and the HAFR areas. Groundwater occurs within the basin fill in shallow

Figure 2-1.
Physiographic Features, Wendover Air Force Auxiliary Field, Utah

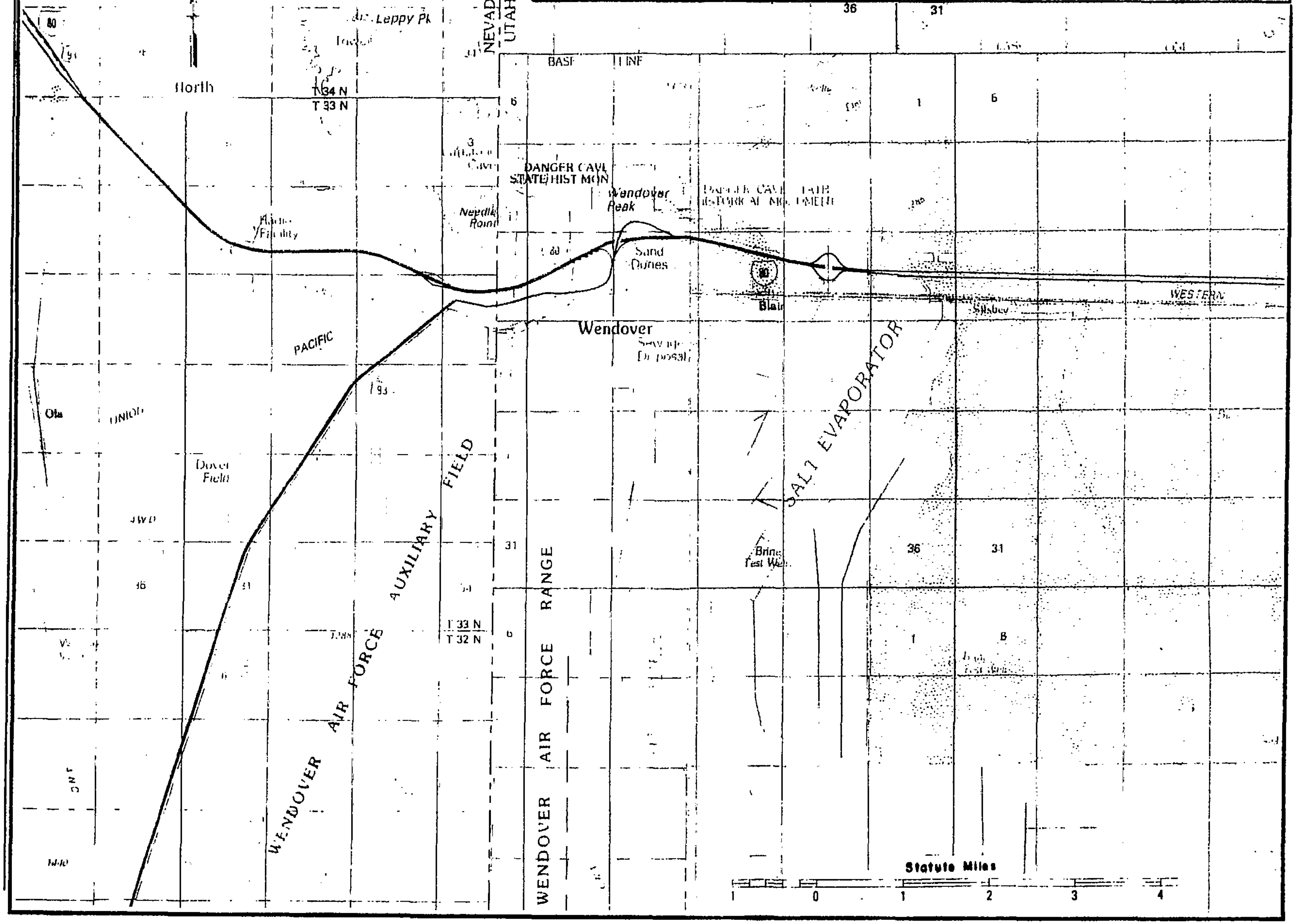


Figure 2-2.
Physiographic Features, Hill Air Force Range

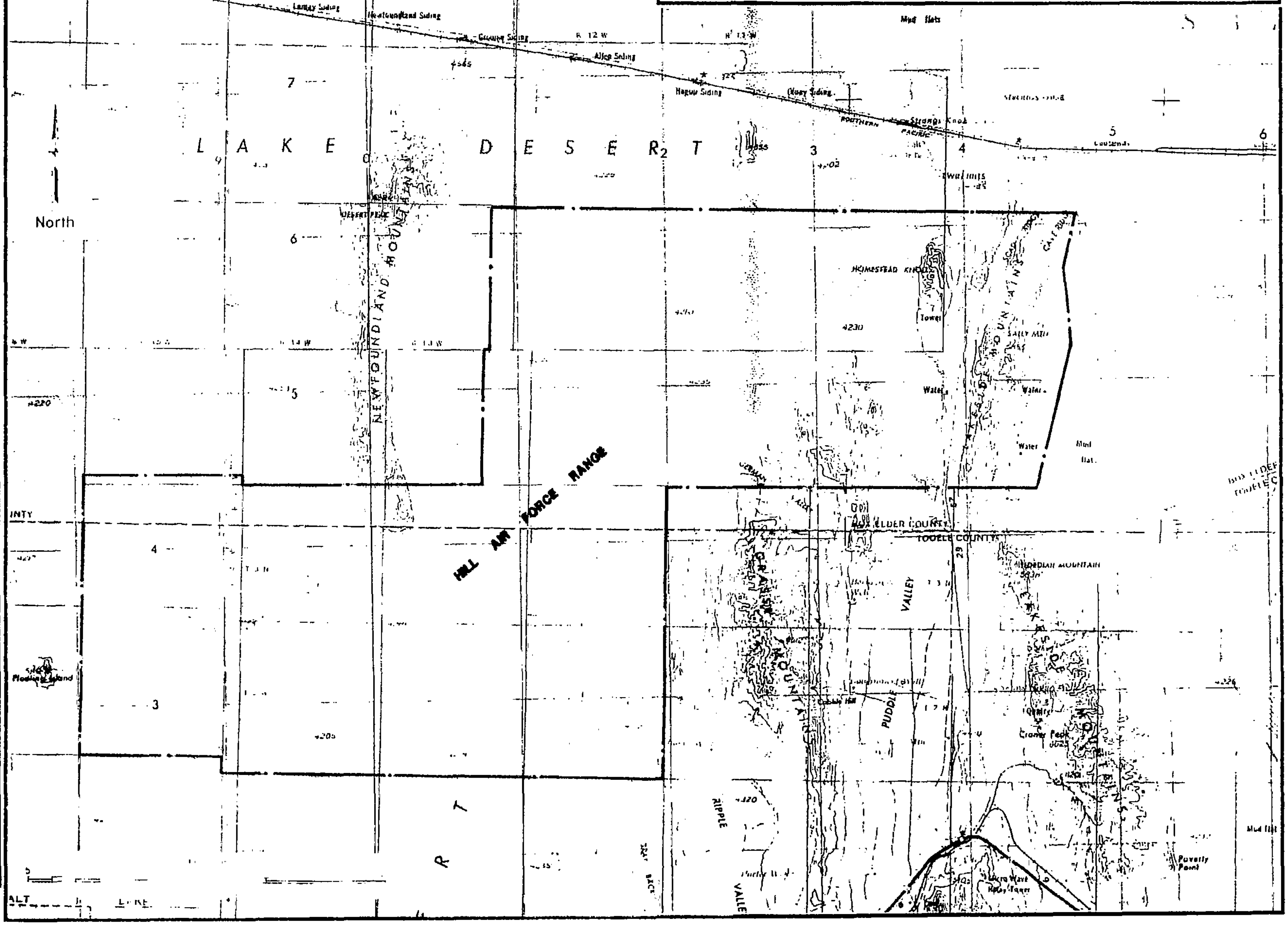


Table 2-1

Meteorological Data
Wendover Air Force Auxiliary Field and Hill Air Force Range

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Temperature (degrees F)													
Maximum	34.9	42.7	51.9	61.3	71.5	82.2	91.6	88.6	77.3	62.5	47.2	35.4	62.3
Average	26.8	33.7	42.2	50.7	60.8	70.9	79.7	76.7	65.6	52.0	38.6	27.6	52.1
Minimum	18.7	24.8	32.4	40.0	50.0	59.6	67.8	64.8	53.9	41.5	30.0	19.9	42.0
Precipitation (inches)													
Mean	0.24	0.32	0.45	0.56	0.90	0.65	0.31	0.46	0.38	0.55	0.38	0.27	5.47
Windspeed													Total
Direction (degrees)	350-010	020-040	050-070	080-100	110-130	140-160	170-190	200-220	230-250	260-280	290-310	320-340	--
Mean Speed (knots)	6.75	5.85	4.05	3.80	4.00	4.85	6.70	6.05	4.70	5.10	7.10	7.70	5.55
Median Speed (knots)	5.5	5.0	3.5	3.5	3.5	3.5	5.0	4.5	3.5	3.5	6.0	6.5	4.5
Total Percent	5.45	5.55	6.55	8.30	8.95	9.45	8.90	4.70	5.50	8.25	9.60	8.50	100*

*Calm Wind = 10.3 Total Percent.
Meteorological data from NOAA (1961 to 1990) and National Weather Service (1950 to 1976).

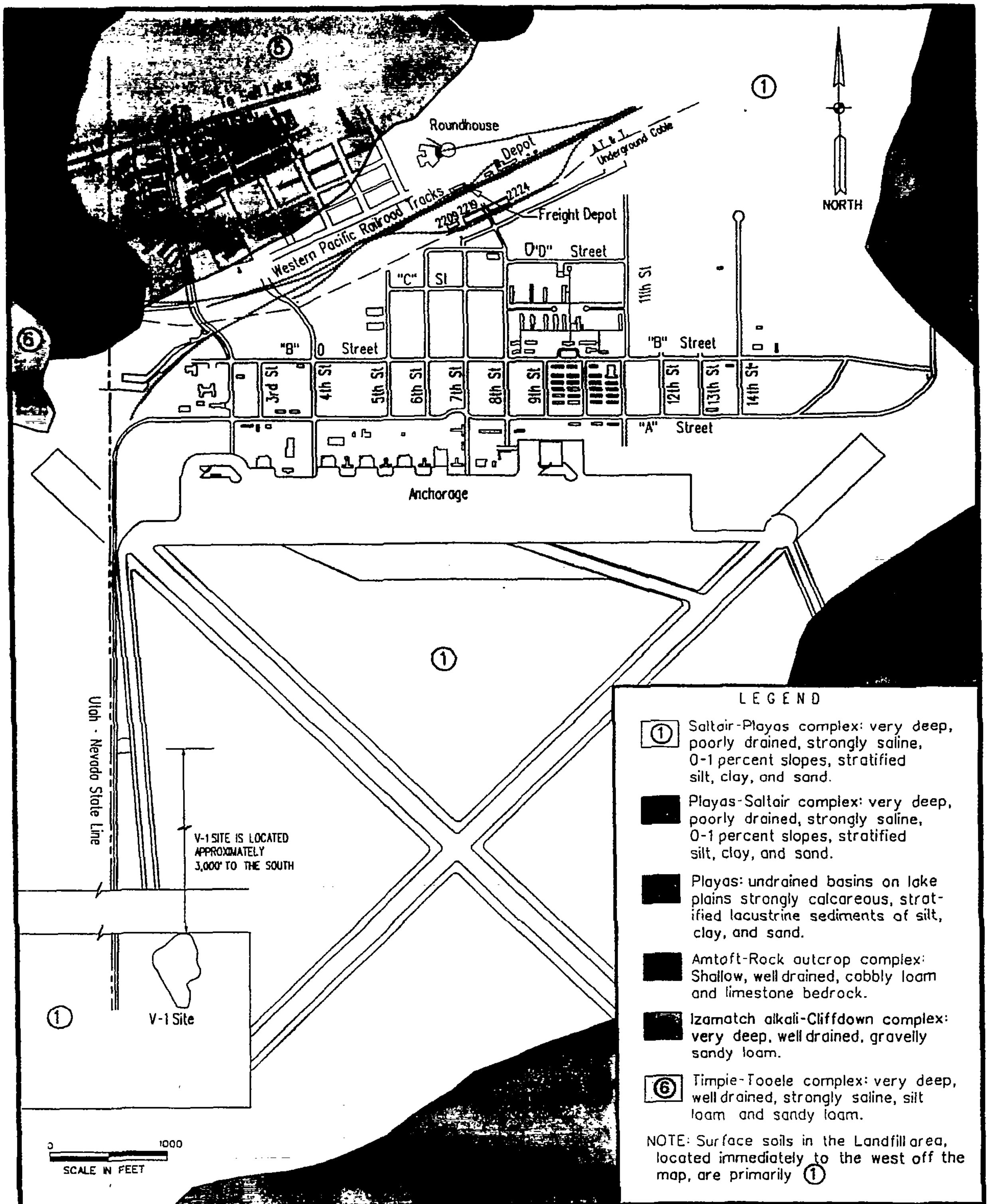
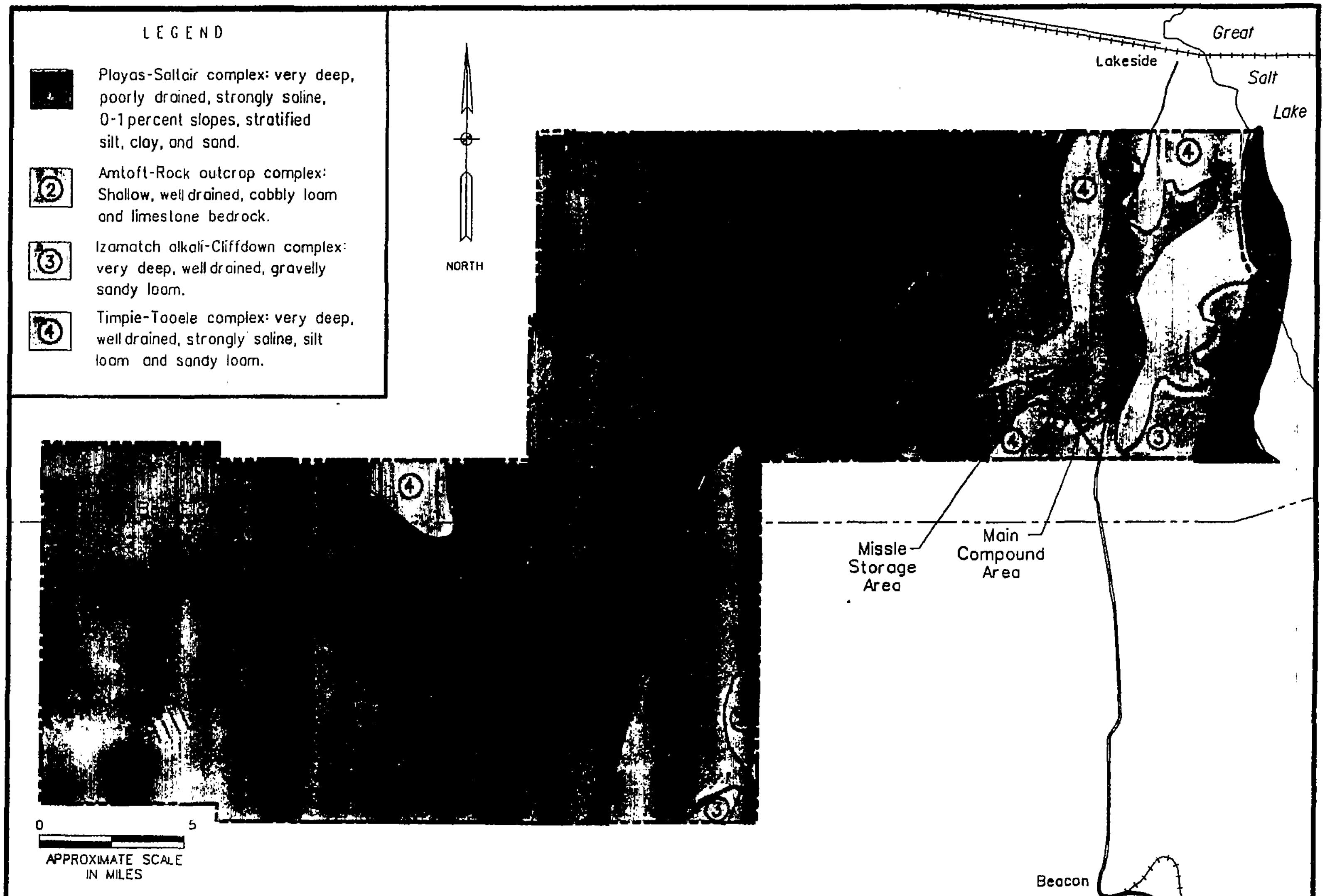


Figure 2-3. Surface Soils, Wendover Air Force Auxiliary Field

SOURCE: United States Department of Agriculture, Soil Conservation Service

MISC8 G106218 SAC



MSCB G10620 SAC

Figure 2-4. Surface Soils, Hill Air Force Range

SOURCE: United States Department of Agriculture, Soil Conservation Service

Approximate Feet BGL	General Stratigraphic Section	Unit	Average Thickness (feet)	Lithologic Description
4		UPPER SAND/SILT	4	SAND AND SILT: light brownish gray to light gray, poorly graded, fine grained, dry to moist, firm to hard, friable
13		UPPER CLAY	9	CLAY: light gray to light olive gray, very soft to firm, silty, minor sandy seams, plastic, moist to wet, sticky
19		MIDDLE SAND/SILT	6	SAND AND SILT: light gray to light olive gray, moist to wet, poorly graded, fine grained, loose, minor clay seams
39		MIDDLE CLAY	20	CLAY: light gray to light olive gray, wet, very soft to firm, silty, minor sandy seams, plastic, sticky
43		LOWER SAND/SILT	4	SAND AND SILT: loose, wet, fine grained
67		LOWER CLAY	>24	CLAY: silty, firm to stiff, wet

Figure 2-5. Subsurface Soil, Wendover Air Force Auxiliary Field

WEND12D.FH3 - VMG 12/14/93 SAC

unconfined units and, at depth, within confined aquifer units. Carbonate rocks consisting of massive to thinly bedded limestones and dolomites with silty and sandy interbeds represent a deeper hydrogeologic unit in the region. The carbonate rocks range in thickness from about 500 to 25,000 ft. Regional transmittal of groundwater occurs from the carbonate rocks to the upper lake sediment aquifer (Bedinger, et al., 1990).

Depth to water at Wendover AFAF and the HAFR ranges from near ground surface to approximately 35 ft below ground level (bgl). The average hydraulic conductivity of the basin fill deposits is 2.3 x 10^{-5} cm/sec (Bedinger, et al. 1990). The approximate hydraulic gradient at Wendover AFAF is 0.002 ft/ft. Shallow groundwater flow directions at Wendover AFAF are south, southeast, and east. In the vicinity of the HAFR, groundwater is believed to flow generally to the east toward the Great Salt Lake.

Water quality is characterized by naturally high dissolved solids in solution. The natural groundwater quality of the shallow basin fill aquifer beneath Wendover AFAF and the HAFR is characterized by a high concentration of total dissolved solids (TDS) that ranges from 500 to 200,000 mg/L. The TDS concentration in groundwater originating from between 300 to 500 ft bgl in the Wendover area ranges from less than 10,000 to as high as 300,000 mg/L (Wadsworth,1993). Reilly Industries, Inc., located immediately southeast of Wendover AFAF, uses groundwater from these depths to commercially produce potash. The major constituents in the groundwater are calcium, potassium, magnesium, and sodium bicarbonate. Groundwater concentrations near the higher dissolved solids range typically contains chloride as the primary anion.

Groundwater in the vicinity of Wendover AFAF is not used for drinking water due to its poor quality. Springs that produce good quality water, however, are known to occur in the mountain ranges surrounding Wendover AFAF. The town of Wendover, Utah, derives its drinking water from springs located about 30 miles away in the Pilot Mountains. Water from the springs is piped to a million-gallon reservoir where it is stored and treated with chlorine. The town of West Wendover, Nevada, obtains its drinking water from Johnson Springs, which is located about 25 miles west of the town. The water is piped to a 1.5 million-gallon storage tank and is treated with chlorine.

Groundwater is used for drinking and fire fighting purposes at the HAFR. One well located in the main compound at the HAFR produces groundwater that is treated using reverse osmosis prior to human consumption.

Groundwater in the vicinity of Wendover AFAF and the HAFR is currently unclassified groundwater under the Utah Groundwater Quality Protection Rules (Whitehead,1993). The naturally high TDS concentrations suggest that if the groundwater were to be classified in the vicinity of Wendover AFAF, it could possibly be designated as either Class III (Limited Use) or Class IV (Saline Groundwater). No wellhead protection zones have been established in the vicinity of either Wendover AFAF or the HAFR (Jensen, 1993).

2.2 Site History

2.2.1 Primary Activities

Wendover Air Force Base (AFB) and the HAFR were established in 1940 when the Air Corps initiated a massive expansion program. Because of its geography and meteorology, the Wendover area made an excellent site for an Air Force Base and bombing range. Procurement of the land for Wendover AFB and the HAFR was easily accomplished, since the Department of the Interior owned virtually all of the original 1,822,000 acres that formed the Base and bombing range. From this beginning, the Base and the HAFR grew until, at its height, they together encompassed 3.5 million acres and represented the largest military reserve in the world. A chronology of the primary activities, operations, and milestones is summarized in Figure 2-6. A historical site map that shows the locations of all the old buildings that were present at Wendover AFB during the peak of its operations is presented as Figure 2-7.

The basic mission of Wendover AFB and the HAFR during World War II was to train heavy bombardment groups; that is, the crews of B-17,

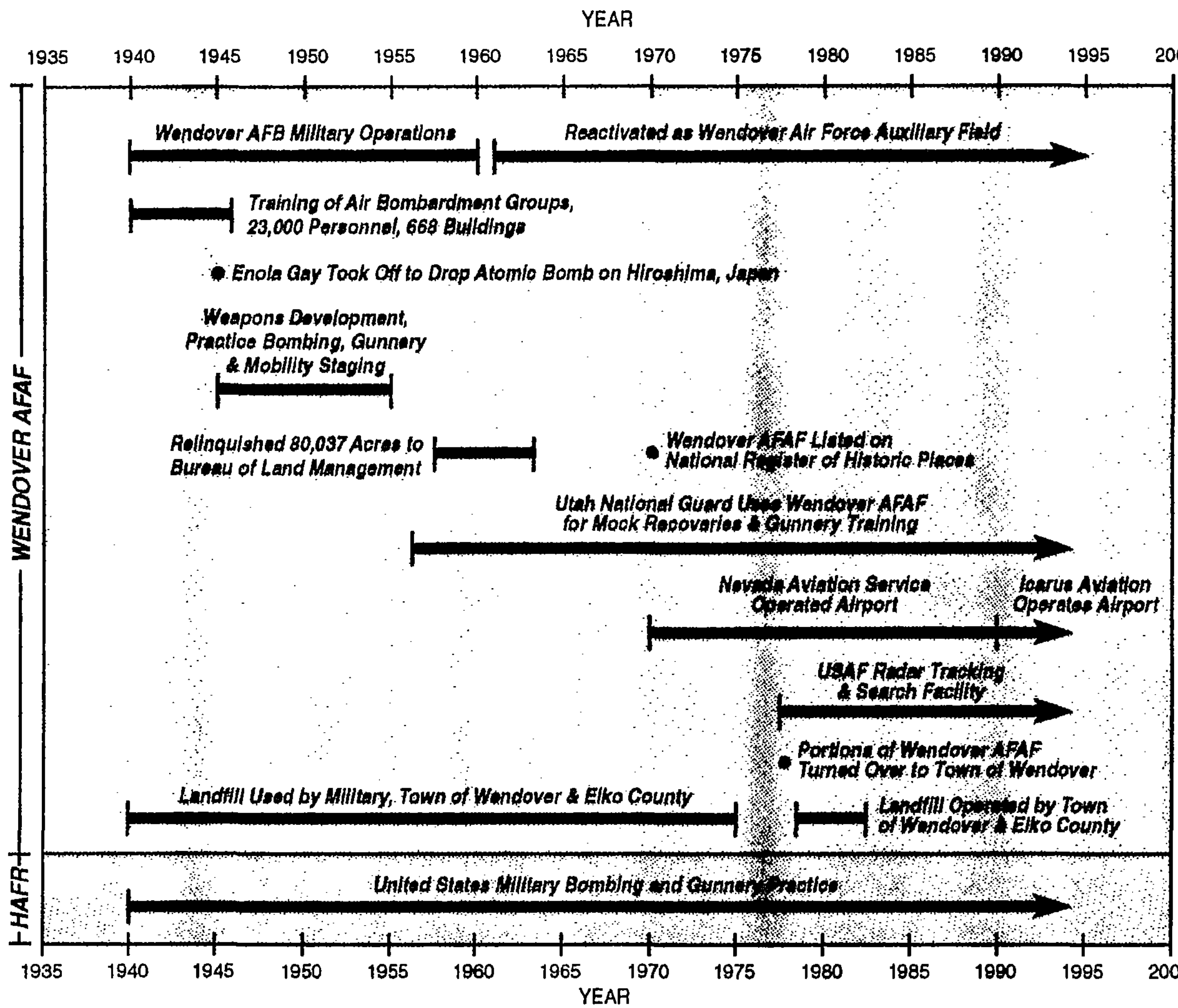
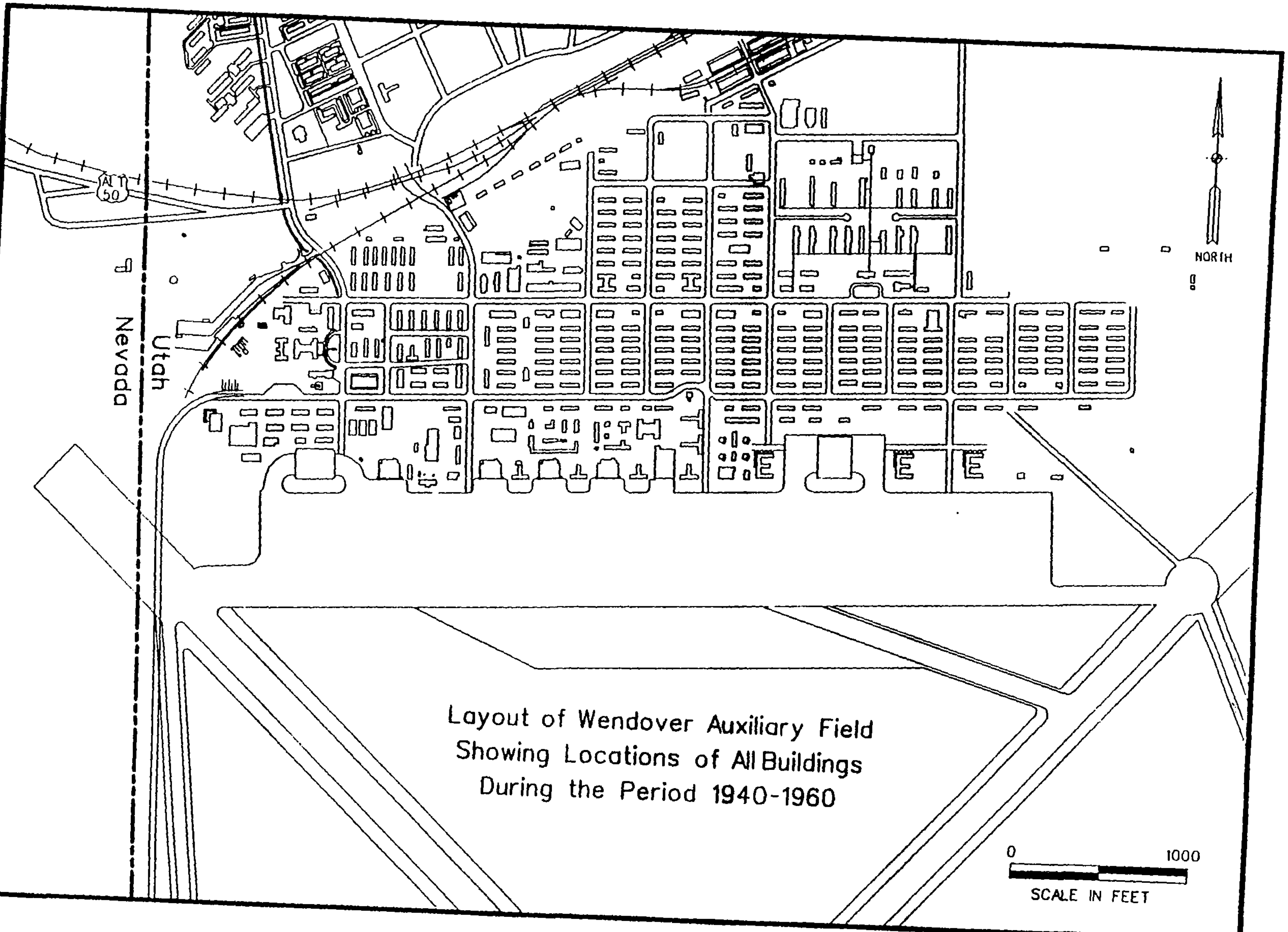


Figure 2-6. Primary Activities at Wendover Air Force Auxiliary Field and Hill Air Force Range

WEND12E.FH3 - VMG 2/17/94 SAC



MSCB G10628L SAC

Figure 2-7. Historical Site Map of Wendover Air Force Auxiliary Field, Utah and Nevada

B-24, and B-29 bombers (Alexander, et al., 1963). With the enormous build-up of troops, the U.S. Army activated a subdepot to store and issue all supplies and property to the Base. A small machine shop opened in 1942, which by 1943 expanded to a hangar, a complete machine shop, a parachute shop, and a bombsight and turret shop. Aircraft and special-purpose vehicles, such as forklifts, were also maintained there. Another Base operation was the training of soldiers and civilians in fire fighting and rescue work. Special facilities were constructed to train these specialists, including a fire drill pit where fuels, solvents, and other flammable liquids were poured onto the ground and ignited.

The most dramatic unit to assemble and train at Wendover AFB and the HAFR was the 509th Composite Group, activated in 1944, under the command of Colonel Paul W. Tibbets, Jr. Its overall mission proved to be without precedent. The arrival of its first B-29 Superfortress marked the beginning of training to drop bombs over Japan. The squadrons comprising the 509th conducted various activities, which included aircraft maintenance, telephone and radio operations, and procurement and distribution of chemical and ordnance supplies. Units were also trained in combat procedures, chemical warfare, first aid, the use of firearms, and camouflage techniques.

In May of 1945, the 509th Group left Wendover for Tinian Island in the Marianas. The Group flew a number of bombing missions over Japan. In July of 1945, President Harry Truman issued the Potsdam Ultimatum urging Japan to surrender. There being no surrender, on 6 August, 1945, Colonel Tibbets flying the Enola Gay, left Tinian to drop the atomic bomb on Hiroshima, Japan.

After the 509th left Wendover AFB in the spring of 1945, the training program slowed to a standstill, and activity was shifted to the development of weapons. The Base's assignment included the testing and development of various types of missiles. Two launching ramps with concrete bases and steel-covered pads were constructed from which to fire the rockets. During this period, the Base also set up a school to train pilots in the techniques of remote control.

From 1947 through the summer of 1954, the Base was used as a practice bombing range. From October 1954 to 1957, the Base was used as a gunnery and mobility and staging area. New jet bombers and fighters were brought to the Base to practice air-to-air and air-to-ground rocketry.

In December 1957, the Utah Air National Guard sought to use the Base for summer encampments. The Air Force Reserve and Air National Guard began using the Base for mock recoveries and gunnery training, uses that continue to the present. In December 1960, the Base was placed on inactive caretaker status, under the management of Hill Air Force Base. The Base was then reactivated in July 1961 as the Wendover Air Force Auxiliary Field. Portions of the Base were turned over to the town of Wendover in 1977.

Although ownership and the uses of the Base at Wendover have shifted throughout its history, the use of the HAFR has remained constant. Since 1940 and continuing to the present, the HAFR has served as a bombing and gunnery range for aircraft from all branches of the military.

2.2.2 Past and Current Land Uses

Maintenance shops, fire station, fire training pit, supply depots, housing and recreational facilities, landfill, salvage yard, wastewater treatment plant, power plant, and gasoline stations were located at the Base beginning in 1940 to support bomber training, and later, weapons development and gunnery activities. Currently, there are approximately 110 remaining military-built structures at Wendover AFAF. Individual building conditions vary from structurally sound to very deteriorated. Approximately 30 of the remaining buildings are being used by a variety of tenants for private or public use. Most of the original hangars and other buildings adjacent to the apron area still exist. There are six remaining hangars: three are currently used for private aircraft storage and the other three are currently vacant and in deteriorated condition.

A salvage yard was used here by the military from the early 1940s until approximately 1960. In the 1970s, part of the debris at the salvage yard was moved to an area to the west and south, located between 13th and 14th streets, and A and B streets. Debris was moved from the salvage yard to accommodate the installation and operation of the Hill Air Force Base and Computer Sciences Corporation radar tracking and search facility, currently in operation.

The landfill was used jointly by the military, the town of Wendover, and Elko County, Nevada, between the years 1940 to 1975. Operation of the landfill was turned over to the town of Wendover and Elko County in 1977. Its use continued until about 1982 when another landfill was established in a different location. The land occupied by the former landfill was withdrawn from public use by DOD in 1942 under Public Land Order 50.

Military activities at Wendover AFB declined through the late 1950s until the Base was deactivated in 1960. The facility included about 97,000 acres. Between 1957 and 1962, approximately 80,000 acres of the Base property was relinquished to the Bureau of Land Management. In 1977 additional Base property was turned over to the town of Wendover.

DOD still retains ownership of some of the land at Wendover AFAF for use as a military reservation. The land turned over to the town of Wendover is currently used for residential, commercial, industrial, and recreational purposes. Some parcels of land are also privately owned. Current land use designations and land ownership are shown in Figures 2-8 and 2-9, respectively.

The primary use of the land by the military is for a radar tracking and search facility. Other military training exercises are conducted periodically. Some of the land and old buildings now owned by the town of Wendover are leased to individuals for residential and commercial purposes. Other small parcels of land are privately owned. There are approximately 15 residents living on the old Base and about 30 more people working as employees of various businesses and for the town of Wendover. The town of Wendover owns the airport that accommodates various private aircraft and one daily commercial flight that brings tourists in to visit the local casinos.

The city of West Wendover, Nevada, is pursuing plans that have not been approved to develop a 1400-acre airport industrial park with its own airport taxi ways, rail spurs, and highway access. West Wendover hopes to acquire 1400 acres from within the old landfill area from Hill Air Force Base and the Bureau of Land Management. The proposed industrial park would be located immediately west of the current airport. The proposed development would accommodate general commercial and industrial tenants.

The HAFR has been utilized continuously for bombing and gunnery practice for military aircraft since 1940, and is owned by DOD. Prior to 1940, the land now occupied by the HAFR accommodated sparse cattle and sheep herding activities. The land surrounding the HAFR, the vast majority of which is owned by the Department of the Interior (Bureau of Land Management), is still used for sparse cattle and sheep herding.

2.2.3 Wastes Generated

Information on the types of wastes generated and waste management practices was sought out early in the PA/SI to help focus the investigation on specific contaminant source areas. Once identified, each potential contaminant source was considered for inclusion as a site for investigation. A summary of the potential contaminant source types, wastes generated, and contaminants of potential concern is presented in Table 2-2.

Personnel interviews and previous investigations (ETC, 1992) served as the basis for identifying: historical waste-generating activities; waste management practices that were typically utilized during past Base operations; and the types of contaminant sources at Wendover AFAF and the HAFR.

Information regarding the generation and management of wastes allowed identification of the wastes thought to be associated with each type of contaminant source. Then with the knowledge of the types of wastes to be expected, the contaminants of potential concern were identified for each contaminant source type.

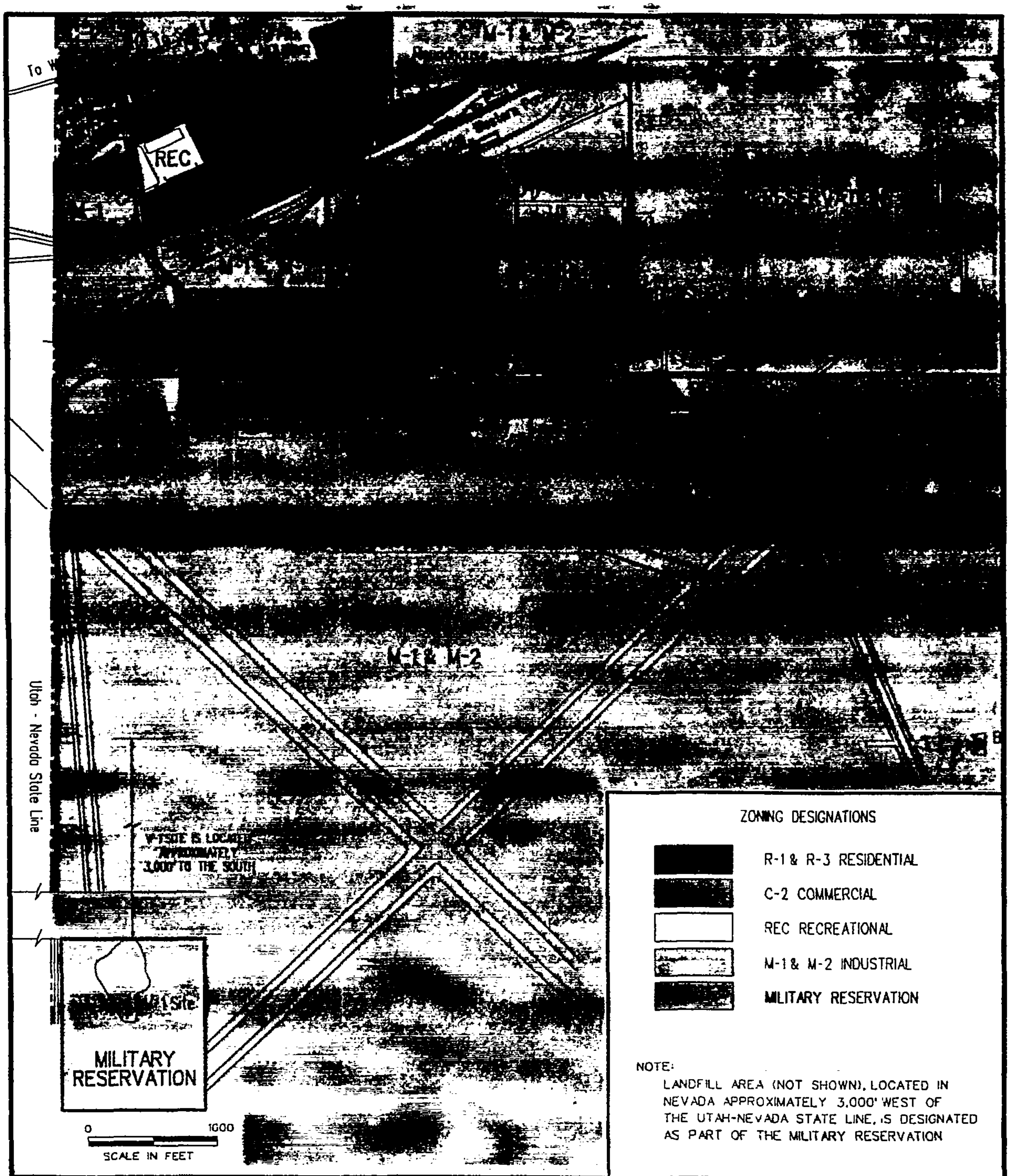


Figure 2-8. Current Land Uses, Wendover Air Force Auxiliary Field

SOURCE: Town of Wendover Zoning Designation Map

MSC8 GI0615C SAC

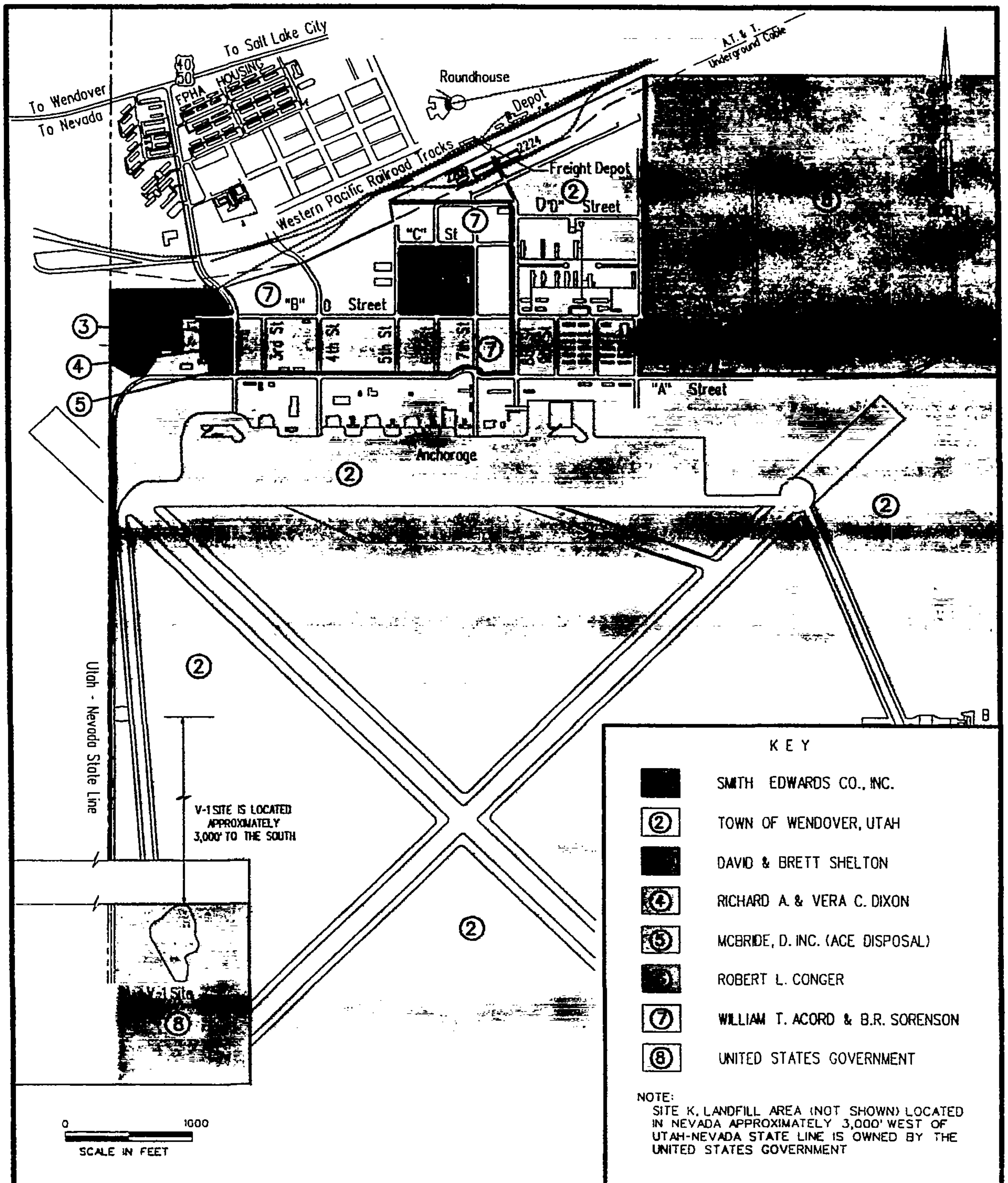


Figure 2-9. Current Land Owners, Wendover Air Force Auxiliary Field

MSC8 G10621A SAC

Table 2-2

Summary of Potential Contaminant Source Types, Wastes Generated, and Contaminants of Potential Concern Wendover Air Force Auxiliary Field and Hill Air Force Range

Potential Source Types	Wastes Generated	Contaminants of Potential Concern
Landfills	Construction rubble, plating mill wastes, spent solvents, and fuels	Metals, asbestos, volatile organic compounds, and petroleum hydrocarbons
Fire drill pits	Fuels, spent solvents and transformer oil	Petroleum hydrocarbons, volatile organic compounds, and polychlorinated biphenyls
Paint/solvent disposal pits	Paints and spent solvents	Metals and volatile organic compounds
Hazardous waste drums	Fuels, solvents and transformer oil	Petroleum hydrocarbons, volatile organic compounds, and polychlorinated biphenyls
Transformers	Transformer oil and spent solvents	Polychlorinated biphenyls and volatile organic compounds
Underground and above ground storage tanks, aircraft engines	Fuels and waste oil	Petroleum hydrocarbons
Motor pool sump/vehicle repair shops	Fuels, waste oil, and spent solvents	Petroleum hydrocarbons and volatile organic compounds
Wastewater treatment plants	Sewage effluent	Petroleum hydrocarbons, volatile organic compounds, metals, and polychlorinated biphenyls
Drainage ditches	Fuels, waste oil, spent solvents and transformer oil	Petroleum hydrocarbons, volatile organic compounds, and polychlorinated biphenyls
Explosive ordnance disposal areas	Various propellants and waste ordnance	Hydrazine, ammonium perchlorate, metals, TNT, DNT, RDX, HMX, and depleted uranium

Section 3
SITE INVESTIGATION

3.1 Objectives and Summary

The purpose of the site investigation was to evaluate areas at Wendover AFAF where past activities may have had a negative impact on the environment. The objective of the investigation was to collect sufficient data to score the sites using the EPA HRS and thereby determine which sites, if any, warrant further action.

Before the site investigation began, interviews were conducted with former Wendover AFAF personnel to identify past activities, wastes generated, and sites of potential concern at the facility. Information obtained during the personnel interviews and from past investigations was used to prioritize the sites for investigation. The sites investigated as part of the PA/SI at Wendover AFAF are delineated in Figure 3-1.

The prioritization of the sites as well as the methods and procedures utilized during the PA/SI are detailed in the *Final Work Plan for Preliminary Assessment/Site Investigation, Wendover Air Force Auxiliary Field and Hill Air Force Range* (Radian, 1993). Minor changes to the original plans were made during the site investigation activities. Any deviations from the *Final Work Plan* are discussed in each of the following sections.

CPT methods were used to determine the subsurface stratigraphy and to collect groundwater and soil gas samples for screening with a portable field gas chromatograph. Analytical field screening of groundwater and soil gas samples was performed to provide initial indications of the presence of volatile organic compounds (VOCs) in the subsurface. Information gained during the CPT activities was utilized to determine which sites warranted the installation of monitor wells and to optimally locate the wells.

Soil samples were collected from above the water table during drilling from all boreholes, including those for monitor wells. Surface soil samples were also collected. All soil samples were analyzed for the entire Resource Conservation and Recovery Act (RCRA) target compound list/target analyte list (TCL/TAL). In addition, soil samples collected from monitor well boreholes were also analyzed for physical properties.

After installation and development of the monitor wells, groundwater samples were collected. All groundwater samples were also analyzed for the entire RCRA TCL/TAL. The number of CPT, soil sampling, and monitoring well locations for each site investigated at Wendover AFAF is summarized in Table 3-1. The number of samples collected and the methods used for chemical analysis are shown in Table 3-2. The logic used for sample identification numbering is presented in Table 3-3. A master log of all samples collected, sorted both by sample identification number and matrix type, is contained in Appendix A.

Background chemical concentrations for neither soil or groundwater were determined during the site investigation. This was because of the location of the Wendover AFAF with respect to other numerous potential contaminant sources as well as changes in soil types, geology, and hydrostratigraphic conditions immediately north (upgradient) of the Base. Efforts were made to sample groundwater and soils in upgradient areas or areas believed to be relatively unaffected by past activities at the Base.

Site 20, Ordnance Disposal Area, was visually inspected at the request of the State of Nevada, Division of Environmental Protection for the presence of unexploded ordnance and hazardous materials. Neither of these substances was found to be present at the remote site.

3.2 Personnel Interviews

Interviews of former and present Base personnel were conducted to obtain information pertaining to past activities and operations, wastes generated, waste management practices, and contami-

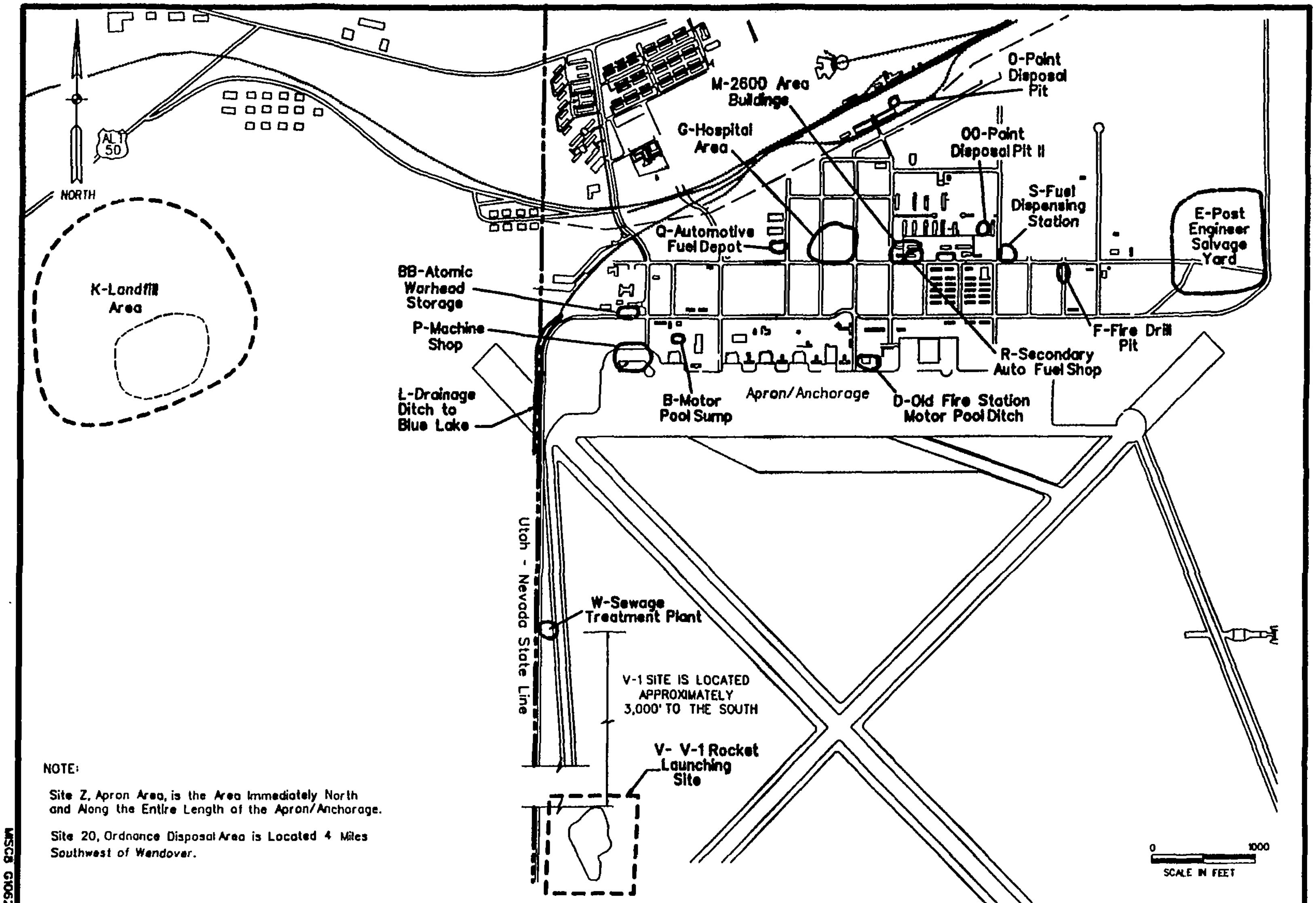


Figure 3-1. Delineation of Sites, Wendover Air Force Auxiliary Field

Table 3-1

Site Investigation Activities
Wendover Air Force Auxiliary Field

Site Location	Site Number	Site Name	Site Investigation Activities				
			Cone Penetrometer Testing Activities				
			Cone Penetrometer Testing Locations	Field Screening of Groundwater Samples	Field Screening of Soil Gas Samples	Soil Sampling Locations	Monitor Wells
Wendover AFAF	K	Landfill	20	16	3	8	4
	V	V-1 Rocket Launching Site	5	5	0	0	0
	E	Post Salvage Yard	11	11	0	6	4
	W	Sewage Treatment Plant	6	6	0	1	1[a]
	P	Hangar 1/Machine Shop	5	5	1	3	1
	L	West Aircraft Drainage Ditch to Blue Lake	5	4	1	3	1[a]
	B	Engineer Motor Pool Sump Box	2	2	0	0	0
	BB	Atomic Warhead Storage Bldg.	2	1	2	1	1
	Q	Automotive Fuel Depot	5	5	1	0	0
	M	2600 Area Buildings	7	5	0	1	1
	D	Old Fire Station Ditch	3	3	0	1	1
	G	Hospital Area (cradle tanks)	8	8	0	0	0
	R	Secondary Auto Fuel Shop	3	3	1	0	0
	S	Fuel Dispensing Station	6	6	0	0	0
	F	Fire Drill Pit	17	17	0	4	1
	O	Paint Disposal Pit	6	6	0	3	1
	OO	Paint Disposal Pit II	0	0	0	3	0

Table 3-1

(Continued)

Site Location	Site Number	Site Name	Site Investigation Activities: Cone Penetrometer Testing Activities: Cone Penetrometer Testing Locations	Site Investigation Activities: Cone Penetrometer Testing Activities: Field Screening of Groundwater Samples	Site Investigation Activities: Cone Penetrometer Testing Activities: Field Screening of Soil Gas Samples	Site Investigation Activities: Soil Sampling Locations	Site Investigation Activities: Monitor Wells
Wendover AFAF	Z	Apron Area	12	12	0	12	3
	20	Ordnance Disposal Areas (4 miles SW of Wendover)	0	0	0	0	0

[a]Monitor wells installed at this site; however, groundwater samples were not collected because no water had entered the well prior to and during water sampling activities. Water was found to be present in the well several weeks later when static water levels were measured in all wells installed during the PA/SI.

Table 3-2

Summary of Soil and Groundwater Sample Analyses
Wendover Air Force Auxiliary Field

Method	Parameters	Field Samples	Duplicate Samples	Matrix Spikes	Matrix Spike Duplicates	Trip Blanks	Field Equipment Rinse	Total Samples
VOL-FS	Field Screening--Volatiles	132	13	-	-	-	-	145
SW-846: 6010, 7060, 7421, 7471, 7740 [a]	Metals	66	7	12-24[b]	12-24[b]	-	6	103-127
SW-846: 8015MP	Nonhalogenated Volatile Organics	66	7	15	15	5	6	114
SW-846: 8080	Organochlorine Pesticides and PCBs	66	7	8	8	-	6	95
SW-846: 8240	GC/MS for Volatile Organics	66	7	20	20	5	6	124
SW-846: 8270	GC/MS for Semivolatile Organics	66	7	10	10	-	6	99
SW-846: 9012	Total and Amendable Cyanide	66	7	10	10	-	6	99
SW-846: 9081	Cation-Exchange Capacity of Soils	18	-	-	-	-	-	18
D-2216	Percent Solids	18	-	-	-	-	-	18
D-2974	Total Organic Content	18	-	-	-	-	-	18
D-422	Grain Size	18	-	-	-	-	-	18
D-4318	Liquid Limit, Plastic Limit, and Plasticity Index of Soils	18	-	-	-	-	-	18
D-5084	Permeability	18	-	-	-	-	-	18

[a]Metals analyses by:

SW-846: 6010 - Sb, Be, Cd, Cr, Cu, Ni, Ag, Tl, and Zn.
SW-846: 7060 - Arsenic
SW-846: 7421 - Lead
SW-846: 7471 - Mercury
SW-846: 7740 - Selenium

[b]6010-14
7060-20
7421-24
7271-12
7740-19

Table 3-3

Sample Numbering Logic
Wendover Air Force Auxiliary Field

Site	Sample Location	Sample Type
E	- 101 -	302

Last Three Digits of Sample Numbers	Sample Type	Sampling Method
000-008	Soil Gas	Cone Penetrometer Testing
100-228	Groundwater	Cone Penetrometer Testing
300-363	Soil	Borehole and Surface Soils
401-418	Groundwater	Monitoring Wells

nant sources at both Wendover AFAF and HAFR. Summaries of the personnel interviews are contained in Appendix B.

At the Wendover AFAF, all of the sites listed both in the *Final Work Plan* (Radian,1993) and in this document that are designated with alphabetical characters (e.g., Site K) were identified during the personnel interviews. At the HAFR, all sites were identified as a result of the personnel interviews.

After individual sites and potential contaminant sources at Wendover AFAF were identified, additional information obtained during the personnel interviews regarding wastes generated and waste management practices was utilized to prioritize the sites for investigation. The prioritization of the sites is detailed in the *Final Work Plan* (Radian,1993).

3.3 Cone Penetrometer Testing

3.3.1 Objective

CPT methods were used to rapidly and inexpensively collect data on site lithologies and stratigraphy, and to provide preliminary information on groundwater gradients. Field analytical methods were utilized to provide a screening level determination of the presence of possible subsurface contamination. Both soil gas and groundwater samples were collected at Wendover AFAF during the CPT activities. These samples were screened in the field for the presence of VOCs with a portable gas chromatograph.

As a deviation from the *Final Work Plan* (Radian,1993), additional CPT and groundwater sampling was performed during the site investigation than previously planned. The additional sampling further defined the stratigraphy and the extent of possible contamination at individual sites within the area of investigation. Additional sites were also investigated beyond those originally planned for CPT activities. To off-set the cost of these additional activities, fewer soil gas samples were collected than originally planned.

3.3.2 Locations

All CPT and soil gas and groundwater screening locations are illustrated in Plate 1. A total of 115 locations at 17 individual sites were investigated using CPT at Wendover AFAF during the PA/SI. Ninety-six CPT soundings were performed to define site stratigraphy, and 123 groundwater samples and 9 soil gas samples were collected to help delineate the extent of possible subsurface contamination.

CPT soundings were completed at an average depth of 31 ft and a maximum depth of 67 ft. Soil gas and groundwater samples were generally collected from the upper (dry to moist) and middle (wet) silty sand units, respectively.

3.3.3 Results

Six distinct stratigraphic units were identified in the subsurface using CPT to a depth of 67 ft. The units consist of upper, middle, and lower silty sands and silty clays. A generalized stratigraphic column of the subsurface soils, which is based in part on the CPT results, is presented in Figure 2-5. A detailed report of CPT data acquisition, sampling equipment, data reduction, data interpretation, and results for each site tested is contained in Appendix C.

The analytical results from field screening of groundwater and soil gas samples for VOCs using a portable gas chromatograph are presented in Table 3-4. A detailed report of the methods, procedures, and results of the field gas chromatograph sample screening is contained in Appendix D.

Field screening analysis detected the presence of acetone, benzene, chloroform, ethylbenzene, tetrachloroethylene (PCE), trichloroethylene (TCE), toluene, methylene chloride, and additional unknown VOCs. The concentrations detected ranged from 0.01 to 8.4 parts per million (ppm).

The highest relative concentrations of VOCs (>1 ppm) were detected at the following sites:

- BB, E, F, L, P, and Z.

Intermediate VOC concentrations (<1 and >0.09 ppm) were detected at the following sites:

Table 3-4

Results of Gas Chromatograph Screening of Soil Gas and Groundwater Samples Collected During Cone Penetrometer Testing Wendover Air Force Auxiliary Field

Site Name	Cone Penetrometer Testing Sample Location	Sample Type	Detected Volatile Organic Compounds (ppm)[a]								
			Acetone	Benzene	Chloroform	Ethylbenzene	PCE	TCE	Toluene	Methylene Chloride	Unknown[b] High - End Compounds
B - Engineer Motor Pool Sump	B-01-141	Groundwater	trace[c]	--	--	--	--	--	--	trace[c]	--
	B-02-142	Groundwater	--	--	--	--	--	--	--	--	--
BB - Atomic Warhead Storage Building	BB-01-006	Soil Gas	--	--	--	<0.04	--	--	<0.03	--	--
	BB-02-005	Soil Gas	--	--	--	--	--	--	--	--	--
	BB-02-143	Groundwater	--	--	--	1-2	--	1-2	--	2-4	--
D - Old Fire Station Ditch	D-01-120	Groundwater	--	--	--	--	--	trace[c]	--	0.144	--
	D-02-121	Groundwater	--	0.045	0.114	--	--	0.037	0.035	--	--
	D-02-122	Groundwater	--	0.027	--	--	--	--	0.007	0.046	--
	D-03-153	Groundwater	--	--	trace[c]	--	--	--	--	0.05	--
E - Post Salvage Yard	E-01-165	Groundwater	--	--	--	--	--	--	--	--	trace[c]
	E-02-164	Groundwater	--	--	--	--	--	--	--	trace[c]	--
	E-03-163	Groundwater	--	--	0.07	--	--	--	--	--	--
	E-04-193	Groundwater	--	--	--	--	--	--	--	--	--
	E-04-194	Groundwater	--	--	--	--	--	--	--	--	--
	E-05-195	Groundwater	1.35	--	--	--	trace[c]	trace[c]	--	--	trace[c]
	E-06-196	Groundwater	--	--	--	--	--	--	--	--	trace[c]
	E-07-197	Groundwater	--	--	--	--	--	--	--	--	--

Table 3-4

(Continued)

Site Name	Cone Penetrometer Testing Sample Location	Sample Type	Detected Volatile Organic Compounds (ppm)[a]								
			Acetone	Benzene	Chloroform	Ethylbenzene	PCE	TCE	Toluene	Methylene Chloride	Unknown[b] High - End Compounds
E - Post Salvage Yard (continued)	E-08-198	Groundwater	8.4	--	--	--	--	--	--	--	--
	E-09-201	Groundwater	1.0	--	--	--	--	--	--	1.0	--
	E-10-202	Groundwater	0.8	--	--	--	--	--	--	--	trace[c]
	E-11-203	Groundwater	0.8	--	--	--	--	--	--	--	trace[c]
	E-11-204	Groundwater	0.8	--	--	--	--	--	--	--	trace[c]
F - Fire Drill Pit	F-01-102	Groundwater	--	--	--	--	--	--	--	--	trace[c]
	F-02-147	Groundwater	--	--	0.68	--	--	--	--	0.66	--
	F-03-104	Groundwater	--	--	--	--	--	--	--	--	--
	F-04-149	Groundwater	--	--	1.1	--	--	--	--	1.2	--
	F-05-150	Groundwater	--	--	--	--	--	--	--	--	--
	F-06-103	Groundwater	--	0.2	--	--	--	--	--	--	--
	F-07-105	Groundwater	--	--	--	--	--	--	--	--	--
	F-08-148	Groundwater	--	--	--	--	--	trace[c]	--	--	--
	F-09-169	Groundwater	--	--	--	--	--	--	--	0.50	--
	F-10-175	Groundwater	--	--	--	--	--	--	--	--	--
	F-11-176	Groundwater	--	--	--	--	--	--	--	0.14	--
	F-12-177	Groundwater	--	--	--	--	--	--	--	--	--
	F-13-178	Groundwater	--	--	--	--	--	--	--	--	--
	F-14-180	Groundwater	--	--	--	--	--	--	--	0.07	--

Table 3-4

(Continued)

Site Name	Cone Penetrometer Testing Sample Location	Sample Type	Detected Volatile Organic Compounds (ppm)[a]								
			Acetone	Benzene	Chloroform	Ethylbenzene	PCE	TCE	Toluene	Methylene Chloride	Unknown[b] High - End Compounds
F - Fire Drill Pit (continued)	F-15-174	Groundwater	0.27	--	--	--	--	--	--	--	trace[c]
	F-16-199	Groundwater	--	--	--	--	--	--	--	--	--
	F-17-223	Groundwater	--	--	0.5	--	--	--	--	--	--
G - Hospital Area	G-01-127	Groundwater	--	--	--	--	--	--	--	--	--
	G-02-128	Groundwater	--	--	--	--	--	--	--	--	--
	G-03-129	Groundwater	--	--	--	--	--	--	--	0.15	--
	G-04-126	Groundwater	--	0.083	--	--	--	--	0.069	--	--
	G-05-130	Groundwater	--	--	--	--	--	--	--	--	--
	G-06-156	Groundwater	--	--	--	--	--	--	--	0.13	--
	G-06-157	Groundwater	--	--	--	--	--	--	--	0.13	--
	G-07-181	Groundwater	--	--	--	--	--	--	--	--	--
	G-08-182	Groundwater	--	--	--	--	--	--	0.05	--	trace[c]
K - Landfill	K-02-100	Groundwater	0.05	--	--	--	--	--	--	0.05	--
	K-03-166	Groundwater	0.5	--	--	--	--	--	--	0.01	trace[c]
	K-04-000	Soil Gas	--	--	--	--	--	--	0.057	--	--
	K-05-160	Groundwater	--	--	--	--	--	--	--	--	--
	K-06-161	Groundwater	--	--	--	--	--	--	--	--	--
	K-07-167	Groundwater	--	--	--	--	--	--	--	--	trace[c]
	K-08-162	Groundwater	--	--	--	--	--	--	--	--	--

Table 3-4

(Continued)

Site Name	Cone Penetrometer Testing Sample Location	Sample Type	Detected Volatile Organic Compounds (ppm)[a]								
			Acetone	Benzene	Chloroform	Ethylbenzene	PCE	TCE	Toluene	Methylene Chloride	Unknown[b] High - End Compounds
K - Landfill (continued)	K-09-007	Soil Gas	--	--	--	--	--	--	--	--	--
	K-10-168	Groundwater	--	--	--	--	--	--	--	trace[c]	--
	K-11-008	Soil Gas	--	--	--	--	--	--	--	--	--
	K-12-186	Groundwater	0.2	--	--	--	--	--	--	--	trace[c]
	K-12-187	Groundwater	0.4	--	--	--	--	--	0.01	--	trace[c]
	K-13-188	Groundwater	0.3	--	--	--	--	--	--	0.07	trace[c]
	K-13-189	Groundwater	0.3	--	--	--	--	--	--	--	trace[c]
	K-14-190	Groundwater	0.5	--	--	--	--	--	--	--	trace[c]
	K-15-191	Groundwater	0.2	--	--	--	--	--	--	--	trace[c]
	K-16-192	Groundwater	0.10	--	--	--	--	--	--	--	trace[c]
	K-17-206	Groundwater	0.10	--	--	--	--	--	--	--	trace[c]
	K-18-207	Groundwater	--	--	--	--	--	--	--	--	trace[c]
	K-18-208	Groundwater	--	--	--	--	--	--	--	--	trace[c]
	K-19-209	Groundwater	--	--	--	--	--	--	--	0.7	trace[c]
	K-20-210	Groundwater	--	--	--	--	--	--	--	0.04	trace[c]
L - West Airfield Drainage Ditch	L-01-004	Soil Gas	--	--	--	--	--	--	--	--	--
	L-01-139	Groundwater	--	--	--	--	--	0.011	0.016	1.12	--
	L-02-140	Groundwater	--	--	--	--	--	--	--	0.08	--

Table 3-4

(Continued)

Site Name	Cone Penetrometer Testing Sample Location	Sample Type	Detected Volatile Organic Compounds (ppm)[a]								
			Acetone	Benzene	Chloroform	Ethylbenzene	PCE	TCE	Toluene	Methylene Chloride	Unknown[b] High - End Compounds
L - West Airfield Drainage Ditch (continued)	L-03-138	Groundwater	~2	~1.0	<0.030	--	--	<0.01	<0.01	0.038	--
	L-04-154	Groundwater	--	--	--	--	0.09	--	--	0.055	--
M - 2600 Area Buildings	M-02-115	Groundwater	--	0.052	--	--	--	--	0.006	--	--
	M-04-116	Groundwater	--	0.008	--	--	--	--	--	--	--
	M-05-118	Groundwater	--	--	--	--	--	--	--	0.14	--
	M-06-119	Groundwater	--	--	--	--	--	--	--	--	--
	M-07-225	Groundwater	--	--	--	--	--	--	--	--	--
O - Paint Disposal Pit	O-01-112	Groundwater	0.131	--	--	--	--	--	--	--	--
	O-02-146	Groundwater	--	--	--	--	--	--	trace[c]	--	--
	O-03-145	Groundwater	--	--	--	--	trace[e]	--	--	--	--
	O-04-113	Groundwater	--	0.95	--	--	--	--	0.328	--	--
	O-05-114	Groundwater	--	--	--	--	--	--	--	--	--
	O-06-183	Groundwater									
P - Hangar I / Machine Shop	P-01-124	Groundwater	1	--	--	--	--	--	--	--	--
	P-02-123	Groundwater	1	--	--	--	--	--	--	--	--
	P-03-003	Soil Gas	--	--	--	--	--	--	--	--	--
	P-03-125	Groundwater	--	--	--	--	--	--	--	--	--

Table 3-4

(Continued)

Site Name	Cone Penetrometer Testing Sample Location	Sample Type	Detected Volatile Organic Compounds (ppm)[a]								
			Acetone	Benzene	Chloroform	Ethylbenzene	PCE	TCE	Toluene	Methylene Chloride	Unknown[b] High - End Compounds
P - Hangar I / Machine Shop (continued)	P-05-144	Groundwater	--	--	--	--	--	--	--	--	2
	P-04-228	Groundwater	--	--	--	--	--	3.5	--	1.82	0.05
Q - Automotive Fuel Depot	Q-01-109	Groundwater	--	--	--	--	--	--	--	--	--
	Q-02-110	Groundwater	--	trace[c]	--	--	--	--	trace[c]	--	--
	Q-02-111	Groundwater	--	--	--	--	--	--	--	--	--
	Q-03-155	Groundwater	--	--	--	--	--	--	--	0.09	--
	Q-04-184	Groundwater									
	Q-05-185	Groundwater	--	--	--	--	--	--	--	--	--
R - Secondary Auto Fuel Shop	R-01-158	Groundwater	--	--	--	--	--	--	--	--	--
	R-01-159	Groundwater	--	--	--	--	--	--	--	--	--
	R-02-002	Soil Gas									
	R-02-117	Groundwater	--	--	--	--	--	--	--	--	--
	R-03-224	Groundwater	--	--	--	--	--	0.02	--	--	--
S - Fuel Dispensing Station	S-01-101	Groundwater	--	--	--	--	--	--	--	--	--
	S-02-151	Groundwater	--	--	--	--	--	--	--	--	--
	S-01-110	Groundwater	--	--	--	--	--	--	trace[c]	--	--
	S-03-107	Groundwater	--	--	--	--	--	--	--	--	--
	S-04-108	Groundwater	--	--	--	--	--	--	--	--	--

Table 3-4

(Continued)

Site Name	Cone Penetrometer Testing Sample Location	Sample Type	Detected Volatile Organic Compounds (ppm)[a]								
			Acetone	Benzene	Chloroform	Ethylbenzene	PCE	TCE	Toluene	Methylene Chloride	Unknown[b] High - End Compounds
S - Fuel Dispensing Station (continued)	S-05-106	Groundwater	--	--	--	--	--	--	--	--	--
	S-06-152	Groundwater	--	--	--	--	--	--	--	--	--
V - V1 Rocket Launching Site	V-01-135	Groundwater	--	--	--	--	--	--	--	--	--
	V-01-136	Groundwater	--	--	--	--	--	--	--	--	--
	V-02-137	Groundwater	--	--	--	--	--	--	--	--	--
	V-03-173	Groundwater	--	--	--	--	--	--	--	--	--
	V-04-172	Groundwater	--	--	--	--	--	--	--	--	--
	V-05-170	Groundwater	--	--	--	--	--	--	--	--	--
	V-05-171	Groundwater	--	--	--	--	--	--	--	--	--
W - Sewage Treatment Plant	W-01-130	Groundwater	--	--	--	--	--	<0.03	--	--	trace[c]
	W-02-132	Groundwater	--	--	--	--	--	--	--	--	--
	W-03-133	Groundwater	--	--	--	--	--	--	--	--	--
	W-04-134	Groundwater	--	--	--	--	--	--	<0.1	--	--
	W-05-211	Groundwater	--	--	--	--	--	--	--	--	trace[c]
	W-06-226	Groundwater	--	--	--	--	--	--	--	--	trace[c]
	W-06-227	Groundwater	--	--	--	--	--	--	--	--	--
Z - Apron Area	Z-01-200	Groundwater	--	--	--	--	--	0.01	--	--	trace[c]
	Z-02-205	Groundwater	--	--	--	--	--	--	--	--	--

Table 3-4

(Continued)

Site Name	Cone Penetrometer Testing Sample Location	Sample Type	Detected Volatile Organic Compounds (ppm)[a]								
			Acetone	Benzene	Chloroform	Ethylbenzene	PCE	TCE	Toluene	Methylene Chloride	Unknown[b] High - End Compounds
Z - Apron Area (continued)	Z-03-222	Groundwater	--	--	--	--	--	--	--	--	--
	Z-04-221	Groundwater	--	--	0.05	--	--	--	--	--	--
	Z-05-220	Groundwater	--	--	--	--	--	--	--	--	--
	Z-06-219	Groundwater	--	--	--	--	--	--	--	--	--
	Z-07-218	Groundwater	--	--	0.05	--	--	--	--	--	--
	Z-08-216	Groundwater	--	--	--	--	--	--	--	--	trace[c]
	Z-08-217	Groundwater	--	--	--	--	--	--	--	--	trace[c]
	Z-09-213	Groundwater	--	--	1	--	--	3.5	--	2	1
	Z-10-212	Groundwater	--	--	2	--	--	2.5	--	1	1
	Z-11-214	Groundwater	--	--	--	--	--	--	--	--	--
	Z-12-215	Groundwater	--	--	0.5	--	--	--	--	--	--

--Compound not detected as a result of gas chromatograph screening.

[a]Benzene, toluene, and ethylbenzene could typically be quantified at concentrations as low as 0.05 ppm. The remaining VOCs could typically be quantified at concentrations as low as 0.3 ppm. Concentration results reported that are below these typical quantification limits should be considered qualitative.

[b]Unidentifiable and unquantifiable VOCs that are lighter in molecular weight and have a lower boiling point than benzene. Their presence was apparent from the chromatogram peaks.

[c]Unquantifiable trace concentrations that are believed to typically be below 0.01 ppm.

- D, G, K, M, and O.

The lowest VOC concentrations relative to the other sites were detected at the following sites:

- B, Q, R, S, and W.

No VOCs were detected at Site V. Trace amounts of VOCs were detected at the majority of the sites investigated. Although the trace amounts were not quantifiable, they are believed to be typically below 0.01 ppm. In addition, several of the sites had unknown VOCs detected. These unknown VOCs were unidentifiable and unquantifiable with the field instrument, but their presence was apparent from the chromatogram peaks.

The sites with the highest and intermediate VOC concentrations were chosen to receive groundwater monitor wells. The only exception to this was Site G, where landowner approval to install a well was not obtained.

The results of the field screening should be considered semiquantitative to qualitative, and do not imply that VOCs not detected by, or below the detection limits of, the portable gas chromatograph are not present at the sites. The aromatic hydrocarbon compounds such as benzene, toluene, and ethylbenzene could be quantified in concentrations as low as 0.05 ppm. The remaining VOCs could be quantified in concentrations as low as 0.3 ppm. Concentration results reported that are below these typical quantification limits should be considered qualitative.

3.4 Soil Sampling

3.4.1 Objectives

Soil analytical data were used to determine impacts to soils from past activities and help identify possible source areas. In addition, chemical analytical data from the soil investigation were used to help calculate waste quantities at the individual sites as part of the site scoring process.

All soil samples were analyzed for the RCRA TCL/TAL. Samples for geotechnical analyses were also collected from monitor well borings to characterize the physical properties of the water-bearing units.

As a deviation from the *Final Work Plan* (Radian,1993), soil samples for chemical analysis were collected from only above the water table. This replaced the original plan to collect soil samples from both above and below the water table. It was believed that detection of possible soil contamination below the water table could be determined indirectly by groundwater analysis. The samples originally planned for collection from below the water table were reallocated to additional boreholes and surface soil samples so that more locations could be investigated.

3.4.2 Locations

Soil samples were collected at a total of 46 locations at 12 individual sites at Wendover AFAF. Eighteen surface soil samples, 28 borehole samples, and 18 geotechnical samples were collected during the PA/SI. Borehole and surface soil sampling locations at Wendover AFAF are presented in Plate 2. Almost the entire area where streets and buildings are located at Wendover AFAF has been covered with a thin layer of sandy gravel fill. The fill was emplaced during base construction to minimize muddy conditions of the fine-grained native surface soil following rainfall events.

Soil samples for chemical analysis were collected from above the water table and below the fill material in the upper silty sand unit. Subsurface soil samples for chemical analysis that were collected during borehole drilling were obtained from a depth of less than 9 ft bgl. Surface soil samples were generally collected from depths ranging from 0.5 to 1.5 ft bgl.

Soil sampling focused on areas thought to be potentially impacted by past activities at the Base. Soils were also sampled in an area believed to be removed from suspected contaminant sources in a location thought to be unaffected by past activities. To collect potentially unaffected samples, surface soils were sampled at location E-105 and subsurface soils were sampled during monitor well drilling at location E-104.

Geotechnical samples were collected from monitor well borings within what would be the screened interval of each completed well. Attempts were made to collect the geotechnical samples from the middle silty sand unit; however, in some locations this unit was very thin and difficult to target for sampling. The samples for geotechnical analyses were collected at a depth averaging 16 feet below ground level (bgl).

3.4.3 Results

Only six contaminant compounds were detected in surface and subsurface soils at Wendover AFAF. All the chemical analytical results of the soil samples collected during the PA/SI were tabulated and sorted by location. Appendix E.1 contains a table presenting these data. A quality assurance/quality control (QA/QC) summary of the analytical data is contained in Appendix F.

The contaminants detected in soils were compared with the proposed RCRA Subpart S action levels. The proposed action levels were used for comparison purposes only and are not intended for use as regulatory soil cleanup standards nor as criteria for further investigation. Although the proposed action levels have not been promulgated, they are health risk-based and provide a conservative approach for evaluating soil contaminant concentrations. To provide the most conservative approach for comparison, the carcinogenic-based proposed action levels were utilized for the compounds that have them established. The samples with organic and inorganic contaminant concentrations exceeding the proposed action levels are identified in Tables 3-5 and 3-6, respectively.

Organic Contaminants

Organic contaminants exceeding action levels were detected at only 4 of the 46 soil sampling locations at the following sites:

- L, O, and Z.

Organochlorine pesticides (aldrin and dieldrin) were detected at concentrations above the proposed action levels at Sites O and Z; however, both the identity and concentration of dieldrin were not confirmed because it was not detected on the secondary column during laboratory analysis.

Aldrin was detected at a concentration of 0.046 mg/kg at location Z-014. Dieldrin was detected as high as 0.149 mg/kg at location O-007; however, its identity and concentration were not confirmed as stated above.

Semivolatile organic compounds were detected at concentrations exceeding the proposed action levels at Sites L and Z. Benzo(a)pyrene was detected at locations L-001 (0.123 mg/kg) and Z-018 (0.345 mg/kg). Benzo(b)fluoranthene was also detected at location Z-018 (0.957 mg/kg).

Inorganic Contaminants

Arsenic and beryllium were the only inorganic constituents detected in soils at concentrations exceeding the proposed action levels at 45 of the 46 locations sampled. Arsenic was detected at concentrations exceeding the proposed action level at the following sites:

- BB, D, E, F, K, L, O, OO, P, W, and Z.

Beryllium was detected in soils at concentrations exceeding the action level at all sites listed above, with the exception of Site F.

Relatively high arsenic concentrations (>10 mg/kg) were detected at Sites O, OO, P, and Z. The highest arsenic concentrations were detected in surface soils at locations Z-019 (23 mg/kg), Z-016 (19.5 mg/kg), Z-014 (17.1 mg/kg), and Z-017 (16.3 mg/kg).

Relatively high beryllium concentrations (>0.3 mg/kg) were detected at Sites BB, K, L, O, P, W, and Z. The highest beryllium concentration was detected in subsurface soils at location BB-101 (0.566 mg/kg).

Physical Properties

The physical properties of soils sampled within the screened intervals of the monitor well borings have been characterized. The results of the

Table 3-5

Distribution of Organic Contaminants in Soil (mg/kg) Exceeding RCRA Subpart S Action Levels

Wendover Air Force Auxiliary Field

	Concentrations Exceeding RCRA Subpart S Action Levels (mg/kg)			
	SW-8080 Organochlorine Pesticides		SW-8270 Semivolatile Organics	
	Aldrin	Dieldrin	Benzo(a)-Pyrene	Benzo(b)-Fluoranthene
RCRA Subpart S Action Level [a]	0.041176	0.04375	0.09589	0.07
L-001-348 [b]			0.123	
O-007-344 [c]		.0862 K		
O-007-344-FD [c]		.149 K		
Z-014-350 [c]	.0486			
Z-018-362 [c]			0.345	0.957 F

K Both the identity and concentration of this compound were not confirmed because the compound was not detected on the secondary column.

F The concentration reported is both benzo(b)fluoranthene and benzo(k)fluoranthene, since they co-elute. There is no RCRA subpart S level for benzo(k)fluoranthene.

[a]U.S. Environmental Protection Agency, 55 Federal Register 30798-30884, 27 July 1990.

[b]Subsurface soil sample collected from above the water table in a borehole at a depth of less than nine feet below ground surface.

[c]Surface soil sample.

Table 3-6

Distribution of Inorganic Contaminants in Soil (mg/kg) Exceeding RCRA Subpart S Action Levels

Wendover Air Force Auxiliary Field

	Concentrations Exceeding RCRA Subpart S Action Levels (mg/kg)	
	Arsenic (SW7060)	Beryllium (SW6010)
RCRA Subpart S Action Level[a]	0.4 [b]	0.162791 [b]
BB-101-334 [c]	2.01	0.566
D-101-300 [c]	3.63	0.185
E-101-302 [c]	4.0	
E-102-304 [c]	2.01	0.188 B
E-102-304-FD [c]	1.26	0.175 B
E-103-306 [c]	2.72	
E-104-330 [c]	1.04	
E-105-358 [d]	0.716	
E-105-358-FD [d]	1.61	
E-106-359 [d]	5.04	0.277
F-004-310 [c]	2.77 F	
F-009-340 [c]	2.72	
F-015-341 [c]	2.14	
F-101-308 [c]	1.31	
K-101-312 [c]	4.5	0.248 B
K-102-314 [c]	4.36	0.296 B
K-102-314-FD [c]	5.78	0.283 B
K-103-316 [c]	5.91	0.204 B
K-104-318 [c]	6.75	0.169 B
K-105-354 [d]	3.44	0.317 B
K-106-355 [d]	1.46	0.429
K-107-356 [d]	4.24	
K-107-356-FD [d]	5.52	
K-108-357 [d]	7.56	

Table 3-6

(Continued)

	Concentrations Exceeding RCRA Subpart S Action Levels (mg/kg)	
	Arsenic (SW7060)	Beryllium (SW6010)
RCRA Subpart S Action Level[a]	0.4 [b]	0.162791 [b]
L-001-348 [c]	9.26	0.394
L-003-347 [c]	6.47	0.35
L-101-320 [c]	3.53	0.274
O-001-311 [c]	8.55	0.182
O-007-344 [d]	8.26	.3 B
O-007-344-FD [d]	15.3	0.233
O-101-326 [c]	1.77	0.175
OO-001-342 [c]	1.71	
OO-002-352 [d]	11.3	0.267
OO-003-353 [d]	5.77	0.165
P-001-322 [c]	11.1	0.388
P-004-323 [c]	6.28	0.42
P-101-328 [c]	4.49	0.281
W-101-343 [c]	8.26	0.361
Z-004-346 [c]	4.46	0.269
Z-009-345 [c]	6.73	0.28
Z-013-349 [d]	13.0	0.244 B
Z-013-349-FD [d]	11.4	0.269
Z-014-350 [d]	17.1	0.346 B
Z-015-351 [d]	14.0	0.272 B
Z-016-360 [d]	19.5	0.220
Z-017-361 [d]	16.3	0.24
Z-018-362 [d]	5.84	0.318
Z-019-363 [d]	23	0.302
Z-101-332 [c]	2.16	0.344

Table 3-6

(Continued)

	Concentrations Exceeding RCRA Subpart S Action Levels (mg/kg)	
	Arsenic (SW7060)	Beryllium (SW6010)
RCRA Subpart S Action Level[a]	0.4 [b]	0.162791 [b]
Z-101-332-FD [c]	1.34	0.404
Z-101-336 [c]	3.52	0.204
Z-103-338 [c]	2.25	0.208

B Result may be biased high. Analyte was detected in method blank.

F Concentration is questionable; analysis of a dilution of this sample gave significantly different results.

[a]U.S. Environmental Protection Agency, 55 Federal Register 30798-30884, 27 July 1990.

[b]Carcinogenic action levels; non-carcinogenic are As 24, Be 400.

[c]Subsurface soil sample collected from above the water table in a borehole at a depth of less than nine feet below ground surface.

[d]Surface soil sample.

geotechnical laboratory soil tests are presented in Table 3-7. A report detailing the geotechnical laboratory soil test results is contained in Appendix G.

The laboratory reported that the content of soluble minerals in the samples reduced the accuracy of the hydrometer tests. This may have negatively impacted the accuracy of the gradation test results of the samples analyzed.

The predominant lithology sampled from the monitor well boreholes was a silty sand. Clayey sand, sandy silt, poorly graded sand and gravel, and lean clay were also determined from grain size distribution. Permeabilities for all the lithologies tested were determined to range between 1.1×10^{-3} and 8.3×10^{-8} cm/sec. Monitor well boreholes were also continuously cored during drilling, and the observed lithologies were logged by the on site geologist. The litho-logic logs of the monitor well boreholes are contained in Appendix H.1. A generalized description of the subsurface soils is presented in Figure 2-5.

The soil units observed during monitor well borehole drilling consist of upper, middle, and lower silty sands and silty clays. Typically, the silty sands are light gray, fine grained, poorly graded, and wet (the upper sand is dry to moist). The silty clay units are light olive-gray, very soft to firm, plastic, and wet.

3.5 Groundwater Sampling

3.5.1 Objective

Groundwater sampling was performed to identify potential contamination from past releases to groundwater from suspected contaminant sources. Representative groundwater samples were collected from 17 monitor wells installed at Wendover AFAF during the PA/SI. All groundwater samples were analyzed for the RCRA TCL/TAL.

A deviation from the *Final Work Plan* (Radian,1993) was the sampling of only 17 instead of 18 wells. Well L-101 was installed in very low permeability sediments. Several days after its installation, no water had entered the well, even though it was known to have been completed in the zone of saturation. A replacement well was installed at nearby location W-101. It too failed to produce water. Both wells remained dry during groundwater sampling activities. Water was found to be present in both wells several weeks later when static water levels were measured in all the wells installed during the PA/SI.

Dedicated bladder pumps were utilized in all 17 wells sampled instead of only the 8 wells originally specified. This was to ensure that comparable and representative samples would be collected from all wells and to eliminate the possibility of cross-contamination between wells.

3.5.2 Locations

Seventeen monitor wells at nine individual sites were sampled at Wendover AFAF during the PA/SI. Groundwater sampling locations and groundwater contours at Wendover AFAF are illustrated in Plate 3.

Sixteen of the 17 monitor wells sampled are located in downgradient areas to detect potential releases to groundwater from suspected contaminant sources. Well E-104 was installed in an area generally upgradient of most of Wendover AFAF. The purpose of this well was to provide groundwater samples from an area thought to be unaffected by past Base activities.

3.5.3 Results

Organic compounds were detected in groundwater samples collected from all 17 monitor wells, including the designated upgradient well. This suggests the presence of organic contamination in groundwater beneath Wendover AFAF. Organic contaminants at concentrations exceeding established regulatory maximum contaminant levels (MCLs), however, were detected in less than half of the 17 monitor wells. Inorganic contaminants at concentrations exceeding the MCLs were detected in groundwater collected from 12 of the 17 monitor wells.

Chemical analytical results from the groundwater samples collected during the PA/SI were tabulated and sorted by location. Appendix E.2 contains a table presenting these data. A QA/QC summary of the analytical data is contained in

Table 3-7

Physical Properties of Soils, Wendover Air Force Auxiliary Field

Monitoring Well	Sample Number	Depth (Feet)	Lithology	Atterberg Limits		Permeability (cm/sec)	Cation Exchange Capacity (meq/100g)	Organic Carbon (mg/kg)
				Liquid Limit(%)	Plasticity Index (%)			
BB-101	BB-101-335	16.0-19.0	Silty Sand w/Gravel (SM)	No-Value[a]	Nonplastic	$7.7x10^{-5}$	6.2	68,000
D-101	D-101-301	11.5-14.5	Silty Sand (SM)	No-Value[a]	Nonplastic	$1.1x10^{-3}$	4.1	60,000
E-101	E-101-303	12.0-15.0	Silty-Clayey Sand (SC-SM)	28	3	$1.3x10^{-4}$	15.0	100,000
E-102	E-102-305	13.0-15.5	Clayey Sand (SC)	32	10	$1.6x10^{-7}$	11.0	74,000
E-103	E-103-307	6.5-9.0	Silty Sand (SM)	No-Value[a]	Nonplastic	$4.1x10^{-5}$	9.9	79,000
E-104	E-104-331	7.5-9.5	Silty Sand (SM)	No-Value[a]	Nonplastic	$4.4x10^{-5}$	6.1	94,000
F-101	F-101-309	8.5-10.5 14.5-15.0[b]	Silty Sand (SM)	29	1	$5.1X10^{-5}$	5.9	22,000
K-101	K-101-313	28.0-31.0	Poorly Graded Gravel w/Sand and Silty Clay (GP-GC)	20	5	$1.2x10^{-6}$	2.8	23,000
K-102	K-102-315	26.5-29.0	Silty-Clayey Gravel w/Sand (GC-GM)	21	4	$1.8x10^{-6}$	5.9	33,000
K-103	K-103-317	25.5-28.5	Clayey Sand w/Gravel (SC)	21	8	$2.3x10^{-8}$	7.9	50,000
K-104	K-104-319	27.0-29.5	Lean Clay w/Sand & Gravel (CL)	21	16	$1.1x10^{-7}$	13.0	15,000
L-101	L-101-321	11.5-13.5 15.0-15.5[b]	Sandy Silt (ML)	No-Value[a]	Nonplastic	$8.3x10^{-8}$	5.1	49,000
M-101	M-101-325	9.0-10.5 12.0-12.5[b]	Poorly Graded Sand w/Silt (SP-SM)	No-Value[a]	Nonplastic	$3.7x10^{-4}$	6.1	63,000

Table 3-7

(Continued)

Monitoring Well	Sample Number	Depth (Feet)	Lithology	Atterberg Limits		Permeability (cm/sec)	Cation Exchange Capacity (meq/100g)	Organic Carbon (mg/kg)
				Liquid Limit(%)	Plasticity Index (%)			
O-101	O-101-327	7.0-9.0	Silty Sand (SM)	No-Value[a]	Nonplastic	$1.1x10^{4}$	3.7	58,000
P-101	P-101-329	12.0-13.5 14.0-14.5[b]	Silty Sand (SM)	No-Value[a]	Nonplastic	$7.3x10^{6}$	3.6	53,000
Z-101	Z-101-333	11.5-13.5 15.5-16.0[b]	Poorly Graded Sand w/Silt (SP-SM)	No-Value[a]	Nonplastic	$5.7x10^{7}$	3.7	66,000
Z-102	Z-102-337	12.0-14.5 15.5-16.0[b]	Poorly Graded Sand w/Silt (SP-SM)	No-Value[a]	Nonplastic	$1.8x10^{4}$	4.2	69,000
Z-103	Z-103-339	12.5-13.0[b] 15.0-17.5	Silty Sand (SM)	No-Value[a]	Nonplastic	$9.9x10^{6}$	5.2	49,000

[a]Liquid limit was not obtained because of the coarse nature of the soil particles.

[b]Core sample used for permeability determination was collected from within a depth interval different from the remaining portion of the sample used to determine the other physical properties of the soils in cases where core sample recovery was insufficient.

Appendix F. The monitor well completion logs, well development forms, and groundwater level survey data are contained in Appendix H.

The analytical results of all groundwater samples were compared with the Utah Division of Environmental Quality MCLs. The Federal Drinking Water Standards MCLs were used for comparison of compounds for which Utah has not established MCLs. Contaminant concentrations detected at Site K, located in the State of Nevada, should be compared with Nevada MCLs; however, they are no more stringent than either the Utah or federal MCLs.

The groundwater analytical results were also compared with concentrations detected in the sample from well E-104, located in an area thought to be upgradient of most of the Base. The presence of organic contamination in the sample collected from E-104 suggests that the groundwater in this upgradient area has been impacted.

There are no on-Base areas that can be considered to be truly upgradient of contamination because of the location of various facilities immediately north (upgradient) of Wendover AFAF. For instance, the Western Pacific railway line and several businesses in the town of Wendover, including automobile service stations, are located immediately upgradient of Wendover AFAF. These and other potential sources could possibly have contributed to groundwater contamination at Wendover AFAF.

Table 3-8 identifies the samples with organic contaminants exceeding the analytical method detection limits (MDLs) in groundwater. Table 3-9 identifies the samples with inorganic contaminants detected at concentrations exceeding the MCLs.

Organic Contaminants

Organic contaminants were detected at all sites where groundwater samples were collected; however, organic contaminant concentrations exceeding the established MCLs were detected in only seven wells at the following sites:

- D, E, F, M, and Z.

VOC concentrations in groundwater exceeded established MCLs at Sites D, M, and Z. The MCL (5 μg/L) for 1,2-Dichloroethane was exceeded in samples collected from wells D-101 (duplicate sample) and M-101. The highest concentration detected in groundwater was 8.02 μg/L from well M-101. The upgradient well, E-104, had 4.21 μg/L 1,2-Dichloroethane in groundwater. The MCL (5 μg/L) for benzene was exceeded in the sample collected from well Z-103 (204 μg/L).

Acetone, for which no MCL is currently established, was detected in groundwater from 13 of the 17 wells sampled at concentrations ranging from 8.39 to 31.5 μg/L. The highest acetone concentrations (>15 μg/L) in groundwater were detected in wells D-101, E-102, E-103, M-101, P-101, and Z-102.

Pesticides (heptachlor and/or heptachlor epoxide) were detected at concentrations exceeding established MCLs in groundwater collected from wells D-101, E-101, E-102, F-101, M-101, and Z-103. The highest concentration of heptachlor was detected in well Z-103 (1.01 μg/L); however, both the identity and concentration of all heptachlor detects were not confirmed because it was not detected on the secondary column during laboratory analysis.

An anomalously high concentration, as compared to the results from other locations, of heptachlor epoxide was detected in well F-101 (284 μg/L); however, it too was not confirmed because it was not detected on the secondary column during laboratory analysis. The next highest concentration of heptachlor epoxide was detected in well Z-103 (4.99 μg/L); however, this reported concentration is estimated because the concentrations detected on the two columns differed by more than a factor of three.

Inorganic Contaminants

Lead, selenium, antimony, and thallium were the only inorganic constituents detected in groundwater at concentrations exceeding the established MCLs. The analytical results of these inorganic constituents may be biased high because analyte was detected in the method blank of most of the samples as indicated in Table 3-9. One or more of these inorganic constit-

Table 3-8

Distribution of Organic Contaminants in Groundwater (ug/L)
Wendover Air Force Auxiliary Field

Compound	Utah DEQ Maximum Contaminant Level (ug/L)	Concentrations Exceeding Method Detection Limits (ug/L)						
		Upgradient Concentrations[a] (ug/L)	BB-101-418	D-101-401	D-101-401-FD	E-101-402	E-102-403	E-103-404
SW-8240 Volatile Organics								
1,2-Dichloroethane	5	4.21		**2.93**	5.23	3.06		
2-Hexanone		2.63				3.56		
Acetone		13.9 B		**9.18**	15.3	11.9 B	25.6	21.6
Benzene	5	ND		**3.72**	4.36			
Carbon Disulfide		6.5 B						
Methyl Ethyl Ketone		3.86 B						
Methylene Chloride	5[b]	ND			2.84 B			
SW-8015MP Petroleum Hydrocarbons								
Benzene	5	ND		**4.35**	4.29			
Ethyl Benzene	700[b]	ND						
Toluene	1000	0.0922 B		**0.15 KB**	0.198 B	0.202 B	0.21 B	0.163 B
Xylene	1000	ND			0.158 KB	0.331 B	0.265	
SW-8270 Semivolatile Organics								
2,4-Dichlorophenol		ND			2.29			
SW-8080 Pesticides and PCBs								
4,4'-DDE		0.0114 K						
Aldrin		0.0116						
Dieldrin		0.01 K	0.0049 K					

Table 3-8

(Continued)

Compound	Utah DEQ Maximum Contaminant Level (ug/L)	Concentrations Exceeding Method Detection Limits (ug/L)						
		Upgradient Concentrations[a] (ug/L)	BB-101-418	D-101-401	D-101-401-FD	E-101-402	E-102-403	E-103-404
Endosulfan I		ND			13.5 K	7.42 K	12.9 K	
Endosulfan Sulfate		0.0133 K						
Endrin	0.2	0.0116 K						
Heptachlor	0.4[b]	0.0136		0.377 K	0.384 K	0.801 K	0.861 K	
Heptachlor Epoxide	0.2[b]	0.0036 P		3.43 P	3.12 P			0.0263 K
alpha-BHC		0.0135						
delta-BHC		0.0192						
gamma-BHC		0.0149	0.005			0.951 K		

Table 3-8

(Continued)

Compound	Utah DEQ Maximum Contaminant Level (ug/L)	Concentrations Exceeding Method Detection Limits (ug/L) Upgradient Concentrations[a] (ug/L)	F-101-405	K-101-407[c]	K-102-408[c]	K-103-409	K-103-409-FD	K-104-410
SW-8240 Volatile Organics								
1,2-Dichloroethane	5	4.21		2.02	2.96	1.11	3.19	2.42
2-Hexanone		2.63						
Acetone		13.9 B		10.3 B	8.82 B	8.39 B	8.98 B	11.0 B
Carbon Disulfide		6.5 B	6.94					
Methyl Ethyl Ketone		3.86 B						3.52 B
SW-8015MP Petroleum Hydrocarbons								
Benzene	5	ND	0.386					
Ethyl Benzene	700[b]	ND	0.053 K					
Toluene	1000	0.0922 B	0.214 B	0.326 B	0.794 B	0.425 B	0.402 B	0.205 B
Xylene	1000	ND			0.551 B		0.241 B	0.232 B
SW-8270 Semivolatile Organics								
bis(2-EthylHexyl) phthalate		ND	1.21					
SW-8080 Pesticides and PCBs								
Aldrin		0.0116	1.88 K					
Dieldrin		0.01 K	12.1 K					
Heptachlor Epoxide	0.2[b]	0.0036 P	284 K					
delta-BHC		0.0192	0.514 P					

Table 3-8

(Continued)

Compound	Utah DEQ Maximum Contaminant Level (ug/L)	Concentrations Exceeding Method Detection Limits (ug/L)						
		Upgradient Concentrations[a] (ug/L)	M-101-413	D-101-414	P-101-415	Z-101-417	Z-102-406	Z-103-412
SW-8240 Volatile Organics								
1,2-Dichloroethane	5	4.21	8.02					3.78
2-Hexanone		2.63						4.07
Acetone		13.9 B	31.5		25.1		16.1	13.7
Benzene	5	ND						156
Carbon Disulfide		6.5 B	7.45				11.9	
Methyl Ethyl Ketone		3.86 B						4.18 B
SW-8015MP Petroleum Hydrocarbons								
Benzene	5	ND						204
Ethyl Benzene	700[b]	ND						0.271
Toluene	1000	0.0922 B	0.175 B	0.168 B		0.492 B	0.203 B	0.364 B
Xylene	1000	ND			0.179 KB		0.384 B	0.404
SW-8270 Semivolatile Organics								
Acenaphthene		ND			0.539			
SW-8080 Pesticides and PCBs								
4,4'-DDE		0.0114 K	5.72 K					
Dieldrin		0.01 K	1.28 K	0.006 K	11.3 K			
Endosulfan I		ND			1.62 K			
Heptachlor	0.4[b]	0.0136						1.01 K

Table 3-8

(Continued)

Compound	Utah DEQ Maximum Contaminant Level (ug/L)	Concentrations Exceeding Method Detection Limits (ug/L)						
		Upgradient Concentrations[a] (ug/L)	M-101-413	D-101-414	P-101-415	Z-101-417	Z-102-406	Z-103-412
Heptachlor Epoxide	0.2[b]	0.0036 P	0.422 P	0.0308 K				4.99 P
alpha-BHC		0.0135		0.0062 K		0.0028		
delta-BHC		0.0192	30.3 K		0.836 P		1.34 P	

░ = Concentrations exceeding either the Utah DEQ or Federal Drinking Water MCL.

B Result may be biased high. Analyte was detected in method blank.

K Both the identity and concentration of this compound were not confirmed because the compound was not detected on the secondary column.

P The identity of this compound was confirmed by primary and secondary column analysis, but the concentration reported is estimated because the concentrations detected on the two columns differed by more than a factor of 3.

ND Compound not detected in sample from upgradient well.

[a]Upgradient concentrations based on sample results from well E-104.

[b]Utah has not established an MCL for this compound. MCL shown is the Federal Drinking Water Standard MCL, Office of Drinking Water, U.S. Environmental Protection Agency.

[c]Contaminant concentrations detected at Site K, located within the State of Nevada, should be compared to Nevada Maximum Contaminant Levels (MCLs). Nevada's MCLs, however, are no more stringent than either the State of Utah or Federal MCLs.

Table 3-9

Distribution of Inorganic Contaminants in Groundwater (mg/L) Exceeding Maximum Contaminant Levels

Wendover Air Force Auxiliary Field

	Concentrations Exceeding Maximum Contaminant Levels (mg/L)			
	SW-7421	SW-7740	SW-6010	
	Lead	Selenium	Antimony	Thallium
Utah DEQ Maximum Contaminant Levels [a]	0.05	0.01	0.006 [b]	0.002 [c]
Upgradient Concentrations [d]	0.0149 B	0.0159	ND	ND
D-101-401	0.985 B			
D-101-401-FD	0.363 B			
E-101-402		0.078		0.00875 J
E-102-403		0.0525	0.016 BJ	0.0083 BJ
E-103-404				0.0242 B
F-101-405				0.0101 BJ
K-103-409				0.0125 J
K-104-410				0.00549 J
M-101-413				0.0112 BJ
O-101-414				0.0266 B
Z-101-417			0.0184 BJ	0.0365 B
Z-102-406			0.0129 BJ	0.0394 B
Z-103-412	2.37 B			

B Result may be biased high. Analyte was detected in method blank.

J Result is less than stated Detection Limit but greater than or equal to specified Reporting Limit.

[a]Contaminant concentrations detected at Site K, located within the State of Nevada, should be compared to Nevada Maximum Contaminant Levels (MCLs). Nevada's MCLs, however, are no more stringent than either the State of Utah or Federal MCLs.

[b]Utah has not established an MCL for antimony. MCL shown is Federal Drinking Water Standard MCL, Office of Drinking Water, U.S. Environmental Protection Agency.

[c]Proposed on May 20, 1992.

[d]Upgradient determination is based on sample results from well E-104.

uents were detected at concentrations exceeding the MCLs in a total of 12 wells at the following sites:

- D, E, F, K, M, O, and Z.

Lead concentrations exceeding the MCL were detected in groundwater samples collected from wells D-101 and Z-103. The highest lead concentration was detected in well Z-103 (2.37 mg/L).

Selenium concentrations exceeding the MCL were detected in samples collected from wells E-101 and E-102. The highest selenium concentration was detected in well E-101 (0.078 mg/L).

Antimony concentrations exceeding the MCL were detected in samples collected from wells E-102, Z-101, and Z-102. The highest antimony concentration was detected in well Z-101 (0.0184 mg/L).

Thallium concentrations exceeding the MCL were detected in samples collected from wells E-101, E-102, E-103, F-101, K-103, K-104, M-101, O-101, Z-101, and Z-102. The highest thallium concentration was detected in well Z-102 (0.0394 mg/L).

Groundwater Flow

Groundwater elevation contours for Wendover AFAF are presented in Plate 3. Groundwater flows generally from areas of higher groundwater elevation to areas of lower groundwater elevation in a downgradient direction. The direction of groundwater flow beneath Wendover AFAF varies, but flows generally to the south-southeast.

Anomalously low groundwater elevations were measured in the vicinity of Site BB, where bedrock was encountered at a depth of about 19 ft below ground surface. Fractured bedrock crops out immediately north of this site. Although not confirmed, it is believed that groundwater may be transmitted from the overlying sediments into the deeper, more permeable fractured bedrock creating a groundwater in this area. Groundwater being drawn downward into the underlying bedrock could explain the depressed groundwater levels in this area.

As noted previously in Sections 3.5.2 and 3.5.3, the monitor well E-104 was installed in an area believed to be unaffected by past Base activities. On the basis of the estimated groundwater flow directions indicated by the groundwater contours, however, well E-104 may in fact be in an area that could be potentially impacted by Site O and other on-Base areas. There are no on-Base areas that can be considered to be truly upgradient of groundwater contamination because of the location of various facilities immediately north of Wendover AFAF that could potentially impact groundwater.

3.6 Surveying

Monitor well and CPT locations were surveyed to allow referencing groundwater elevations to mean sea level. Contouring of water levels relative to sea level allows groundwater flow directions beneath Wendover AFAF to be estimated. Appendix I contains the survey data for the monitor well and CPT locations.

Section 4
PATHWAY AND ENVIRONMENTAL HAZARD ASSESSMENT

4.1 Conceptual Site Model

A conceptual site model of Wendover AFAF is presented in Figure 4-1. The model illustrates some of the types of contaminant sources and potential exposure routes at Wendover AFAF. The cross section showing subsurface soils, although generalized, is based on CPT and borehole drilling data obtained during the PA/SI.

The conceptual framework for both Wendover AFAF and the HAFR is shown in Figure 4-2. The primary and secondary contaminant sources are listed along with the primary and secondary mechanisms for the release of potential contaminants. The pathways by which potential contamination could migrate are listed and the receptors that could be potentially exposed to possible contamination at both Wendover AFAF and/or the HAFR are identified. The likelihood of exposure of receptors to possible contamination through each migration pathway is discussed in the sections that follow.

4.2 Soil

4.2.1 Impacts to Soil

To characterize potential impacts to soil from past activities and identify possible contaminant source areas, surface and subsurface soils were sampled at 46 locations at 12 of the sites at Wendover AFAF. All soil samples were analyzed for the RCRA TCL/TAL. No soil samples were collected from the HAFR during the PA/SI.

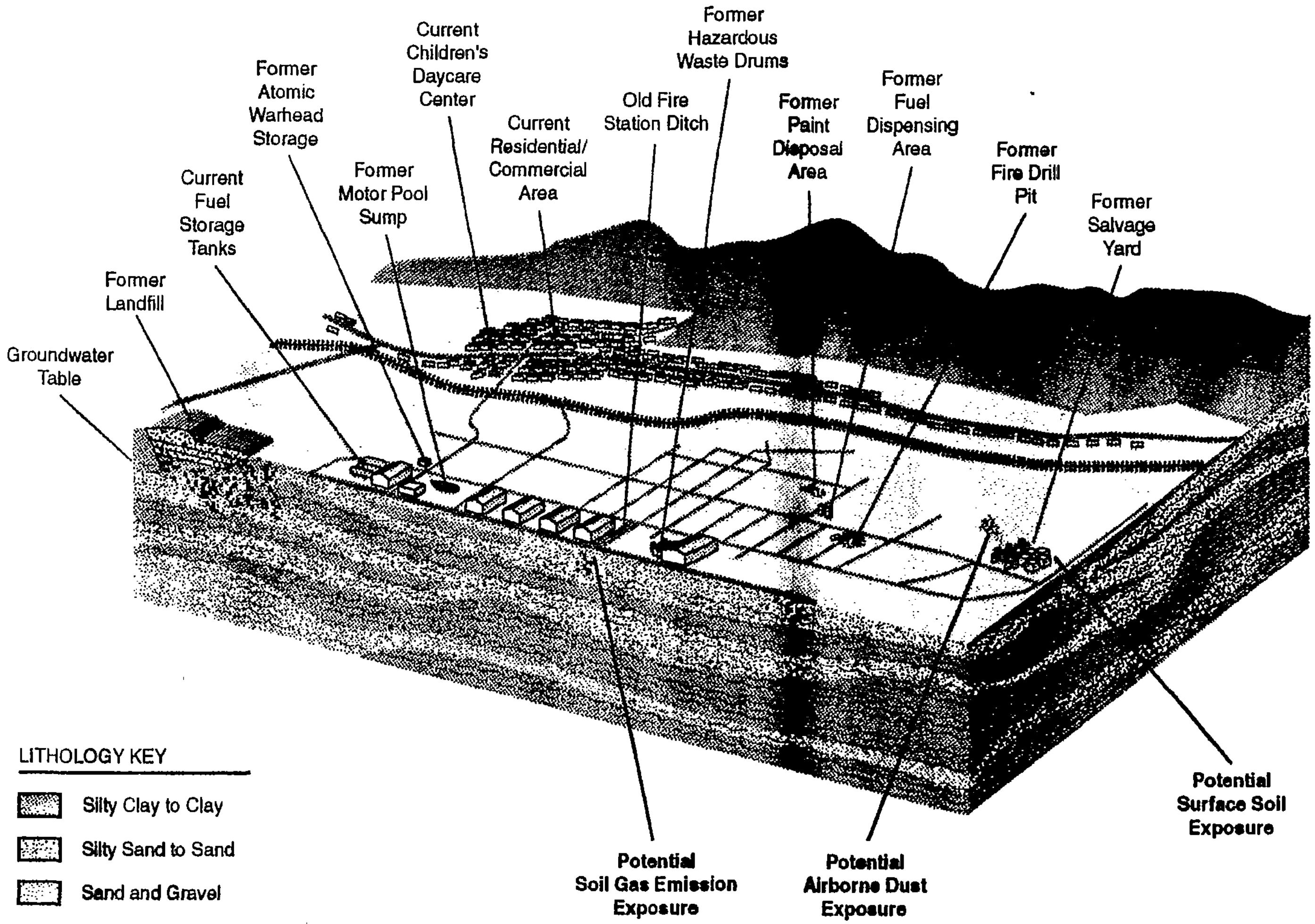
Chemical analytical results of the soil samples were compared with the proposed RCRA Subpart S action levels for each contaminant compound detected. The proposed action levels were used for comparison purposes only and are not intended for use as regulatory cleanup standards nor as criteria for further investigation of soil contamination. The proposed action levels have not been promulgated. A detailed discussion of the analytical results, along with tables identifying the contaminant compounds exceeding the proposed action levels, is presented in Section 3.4.3.

The concentrations and numbers of organic and inorganic contaminants detected indicate minimal impacts to the surface and subsurface soils at Wendover AFAF. Plate 4 illustrates the contaminants exceeding the proposed action levels at the various sites at Wendover AFAF. The contaminants detected in soils are generally the heavier, more persistent, and less easily degraded compounds (pesticides, semivolatile organics, and metals).

With knowledge of the past activities and waste management practices at Wendover AFAF, VOCs in soil were anticipated at the sites investigated. The complete absence of VOCs at concentrations exceeding the action levels suggests that sufficient time has passed to allow any VOCs in the soil to leach downward to groundwater or volatilize to the atmosphere and disperse, or to be naturally degraded by microbial activity in the soil. The most significant potential contamination-causing activities at Wendover AFAF were conducted from 1940 to 1960, thus 33 to 53 years have passed to allow natural processes to act in degrading and dispersing VOC contamination that may have been previously present in the soils.

A total of only six compounds (four organic and two inorganic) were detected in surface and subsurface soils at elevated levels (concentrations exceeding the proposed action levels) at 11 of the 12 sites sampled. The organic compounds exceeding the action levels were detected in soils at Sites L, O, and Z. The organic contaminants include organochlorine pesticides (aldrin and dieldrin) and semivolatile organic compounds (benzo(a)pyrene and benzo(b)fluoranthene). As discussed in Section 3.4.3, both the identity and concentration of dieldrin were not confirmed because it was not detected on the secondary column during laboratory analysis. No VOCs were detected in soils at concentrations exceeding proposed action levels.

Arsenic and beryllium were the only inorganic constituents detected in soils at concentrations



WEND12A.FH3 - VMG 2/9/94 SAC

Figure 4-1. Conceptual Site Model - Wendover Air Force Auxiliary Field

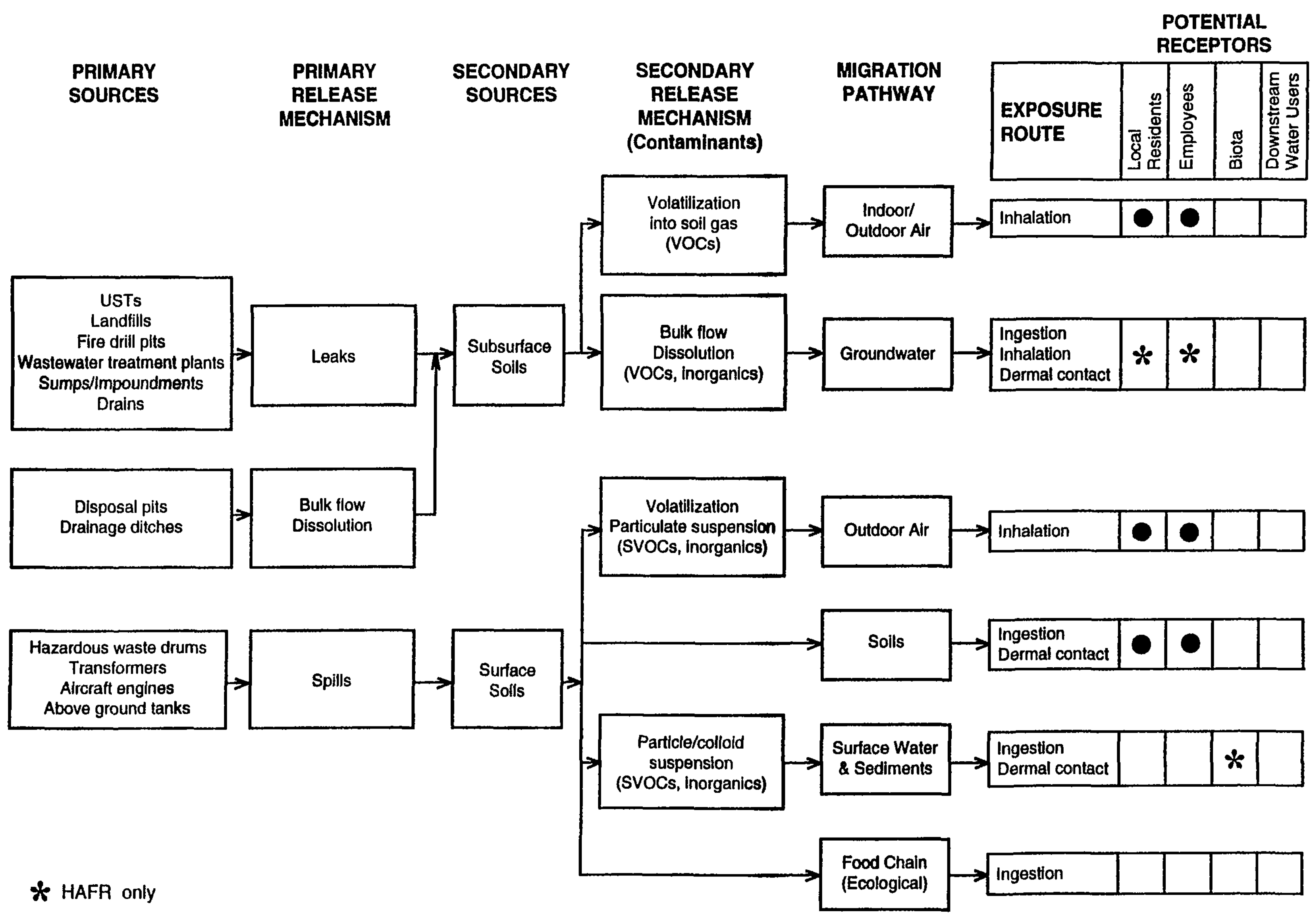


Figure 4-2. Conceptual Framework for Wendover Air Force Auxiliary Field and Hill Air Force Range

exceeding the proposed action levels. At least one of the two metals was detected at 45 of the 46 locations sampled. Arsenic was detected above the action level at all but one site (Site M), and beryllium was detected at all but two sites (Sites F and M). Arsenic and beryllium were detected at a high percentage of the locations sampled, including upgradient locations E-104 and E-105. It is likely that the concentrations detected occur naturally in the soils.

4.2.2 Likelihood of Exposure

There is potential for exposure through the surface soil pathway in source areas of contamination. The surface soil pathway is defined by the presence of hazardous substances detected during soil sampling in the upper 2 ft of the soil. The surface soil pathway assumes contact with hazardous substances at the site rather than migration of these substances from the site.

The surface soil exposure pathway includes three categories of potential targets. Human, environmental, and resource receptors located on or within 200 ft of a potentially contaminated area are considered the resident, or on-site, potential receptor populations. The potential that residents within the surrounding areas will contact site-related contamination is addressed by considering potential receptors. For each of the sites, potential receptors were identified and evaluated on the basis of their presence on, or distance from, potentially contaminated areas.

On-site and nearby residents and worker populations were determined from interviews of Air Force and town of Wendover personnel. Table 4-1 shows the breakdown of the on-site and nearby residents and workers for each site evaluated. It should be noted that on-site residents and workers are weighted more heavily in the risk of exposure calculations than are nearby, but off-site residents and workers. The soil exposure pathway considers only those residents and workers within 1 mile of the sites.

Potentially affected resources for this pathway are agricultural, silvicultural (forestry), and livestock production and grazing activities. This pathway could affect only those potential resources located within 200 ft of a surficially contaminated site. None of these resource activities are known to occur within 200 ft of a Wendover AFAF or HAFR potentially contaminated area; therefore, there are no potential impacts.

Environmental receptors for this pathway are critical habitats for endangered or threatened species and state lands designated for wildlife management. The surface soil pathway is concerned with only those environmental receptors located within 200 ft of a contaminated site. No known sensitive environmental receptors are located within that distance.

4.3 Surface Water

4.3.1 Potential for Release to Surface Water

The surface water pathway consists of two migration components. They are overland flow to surface water and groundwater flow to surface water.

Surface water in the area of Wendover AFAF and the HAFR does not occur in permanent, naturally occurring streams and groundwater does not discharge above ground level to sustain surface water flow. Any surface drainages would contain water only during brief episodes following snow melt and storm events. The majority of this runoff infiltrates into unconsolidated sediments or evaporates before flowing onto lake bed sediments. Therefore, the potential for release of hazardous constituents from contaminated areas to surface water would be limited to periods of flash flooding, in which water may flow across areas of surficially contaminated surface soils. Contaminants from these episodes would only be expected to travel limited distances before being deposited on the soil surface or infiltrate into the subsurface. Thus, the potential for release to surface water is expected to be minimal.

4.3.2 Likelihood of Exposure

The potential for exposure through the surface water pathway addresses contamination of drinking water supplies, human food chain organisms, and sensitive environments. Exposure through this pathway is based on contact of hazardous substances through ingestion of contaminated water or food.

Table 4-1

Resident and Worker Populations
Wendover Air Force Auxiliary Field and Hill Air Force Range

Site Name	Number of On-Site Residents/ Workers	Number of Residents/ Workers >0 - 0.25 miles	Number of Residents/ Workers >0.25 - 0.5 miles	Number of Residents/ Workers >0.5 - 1 miles
B--Engineer Motor Pool Sump	1	22	44	1100
BB--Atomic Warhead Storage Building	6	20	40	1100
D--Old Fire Station Ditch	5	0	15	1100
E--Post Salvage Yard	0	11	0	4
F--Fire Drill Pit	0	6	0	15
G--Hospital Area (cradle tanks)	0	18	1115	1400
K--Landfill	0	6	56	1650
L--West Aircraft Drainage Ditch to Blue Lake	0	0	1115	1400
M--2600 Area Buildings	0	15	1100	1400
O--Paint Disposal Pit	0	11	1115	1400
OO--Paint Disposal Pit II	0	15	13	76
P--Hangar 1/Machine Shop	0	22	43	1100
Q--Automotive Fuel Depot	3	8	33	1100
R--Secondary Auto Fuel Shop	0	6	33	1100
S--Fuel Dispensing Station	0	17	10	1100
V--V-1 Rocket Launching Site	0	0	0	0
W--Sewage Treatment Plant	0	22	1100	1400
Z--Apron Area	0	8	7	1100
HAFR	0	0	0	87

The evaluation of surface water receptors involves identification of intakes supplying drinking water, fisheries, and surface water sensitive environments within a 15-mile target distance of the site. For each of the sites, receptors were identified and evaluated on the basis of their distance from areas of suspected contamination.

In the vicinity of Wendover AFAF, there are two perennial bodies of surface water. One body consists of several aqueducts used to convey spring water 30 miles to the town of Wendover. These aqueducts are located topographically upgradient of Wendover AFAF and would not likely be impacted by contamination from Wendover AFAF. The second body consists of evaporation ponds located east and south of Wendover AFAF used to mine potash and other minerals. Although surface water from Wendover AFAF could potentially discharge to these ponds, these ponds do not supply drinking water and they do not support human food chain organisms. Thus, the potential for exposure at Wendover AFAF through the surface water pathway is expected to be nonexistent. For this reason, this pathway was not scored.

In the vicinity of the HAFR, there is one perennial body of surface water, the Great Salt Lake. Although surface water from contaminated sites at the HAFR could ultimately discharge to the Great Salt Lake, the Lake does not supply drinking water and does not support human food chain organisms. There are some intermittent streams that supply water for livestock outside the boundaries of the HAFR. These are not expected to receive runoff from the HAFR-contaminated sites. Thus, the likelihood of exposure for the HAFR through the surface water pathway is expected to be minimal.

4.4 Groundwater

4.4.1 Releases to Groundwater

To assess the potential hazards of a release, it is critical to determine whether a hazardous substance is likely to have been released and whether any drinking water wells or springs are likely to be exposed to hazardous substances as a result of that release.

The natural groundwater quality of the shallow basin fill aquifer beneath Wendover AFAF and the HAFR is characterized by high concentrations of dissolved solids (500-200,000 mg/L). The principal naturally occurring constituents in the groundwater are calcium, magnesium, sodium bicarbonate, potassium, and chloride.

To evaluate potential releases to groundwater, samples were collected from 17 monitor wells at nine individual sites within Wendover AFAF. All groundwater samples collected were analyzed for the RCRA TCL/TAL. A detailed discussion of the analytical results, along with tables identifying the organic contaminant compounds exceeding MDLs and inorganic compounds exceeding MCLs, is presented in Section 3.5.3. No groundwater samples were collected at the HAFR during the PA/SI.

The concentrations of organic and inorganic contaminants detected in groundwater samples indicate groundwater beneath Wendover AFAF has been impacted. A total of eight compounds (four organic and four inorganic) were detected in groundwater at levels exceeding MCLs. These compounds were detected at seven of the nine sites where groundwater samples were collected.

Organic contaminants were detected above MCLs at five sites (Sites D, E, F, M, and Z). The organic compounds detected above the MCLs include pesticides (heptachlor and heptachlor epoxide) and VOCs (benzene and 1,2-dichloroethane). In addition, organic contaminants were detected at concentrations below the MCLs but exceeding the analytical MDLs in groundwater collected from all 17 monitor wells. A total of 25 organic contaminants were detected. This information indicates the presence of organic contamination in groundwater beneath Wendover AFAF.

The highest concentrations of organic contaminants were detected in groundwater at four sites (Sites D, F, M, and Z). Compared to all concentrations of organics detected in groundwater, relatively high levels of VOCs were detected at Sites M and Z; relatively high levels of semivolatiles were detected at Sites D and F; and relatively high levels of pesticides were detected at Sites D, F, M, and Z.

In addition, acetone was detected at concentrations as high as 31.5 μg/L (no MCL is currently established for acetone) in groundwater from 13 of the 17 wells sampled. The highest concentrations of acetone were detected in groundwater at five sites (Sites D, E, M, P, and Z).

Lead, selenium, antimony, and thallium were the only inorganic contaminants detected in groundwater at concentrations exceeding the established MCLs. One or more of these constituents were detected at concentrations exceeding the MCLs in a total of 12 wells at seven sites (Sites D, E, F, K, M, O, and Z). It should be noted, however, that the analytical results of these inorganic constituents may be biased high because analyte was detected in the method blank of most of the samples as indicated on Table 3-9.

4.4.2 Likelihood of Exposure

The potential for exposure through the groundwater pathway addresses groundwater used as a source of drinking water, groundwater used as a resource, and the existence of nearby wellhead protection zones. The groundwater resource is used for irrigation, livestock watering, commercial food preparation, aquaculture, or recreation (i.e., spring-fed lakes, etc.). The groundwater pathway includes both direct ingestion of hazardous substances and ingestion of contaminated food chain organisms and contact with contaminated water.

Although groundwater is used for mineral production in the vicinity of Wendover AFAF, groundwater is not used for drinking or as a resource, as defined above. In addition, there are no wellhead protection zones near Wendover AFAF. Thus, the potential for exposure through the groundwater pathway near Wendover AFAF is nonexistent, and this pathway was not scored.

In the vicinity of the HAFR, however, groundwater is used to supply water for domestic needs, including drinking, for the 87 people who live and work on the facility. In addition, groundwater is used for stock watering within 4 miles of the facility. It is suspected that these wells are located at least 5000 ft from any site of contamination at the HAFR; thus, the potential for contamination of these sources is moderate, and the potential for exposure through this pathway is expected to be moderate.

4.5 Air

4.5.1 Potential for Release to Air

The principal threat under the air migration pathway is the threat of airborne releases of hazardous substances in vapor or airborne particles (e.g., fugitive dust). Evaluation of targets is primarily concerned with identifying and evaluating the human population within a 4-mile target distance of a site and sensitive environmental receptors and resources within 0.5 miles of a contaminated area. Unlike the other migration pathways, a suspected release to the air itself is sufficient to identify primary receptors.

No odors have been reported nor has a release of hazardous substances to the air been directly observed. There are no known reports of adverse health effects potentially resulting from migration of hazardous substances through the air or analytical/circumstantial evidence to suggest that a release has occurred to the air. No release is suspected.

4.5.2 Likelihood of Exposure

The potential for exposure through the air pathway considers the nearest receptor, population, resources, and sensitive environments located near the site. For the air pathway, resource is redefined to include commercial agriculture activities, commercial silviculture activities, and recreation areas.

Table 4-1 (Section 4.2.2) lists the residents and workers within 1 mile of the sites. These values were used to calculate likelihoods of exposure for those sites with observed soil contamination within the upper 2 ft of soil. Sites with soil contamination at depths greater than 3 ft are assumed to not pose a threat through the air pathway.

For Wendover AFAF, both a resource and a sensitive environment that may be potentially impacted by hazardous substances are found at the site. The resource is a softball field located in the town of Wendover. The sensitive environment is the Danger Cave State Park and Historical Monument. Thus, potential exposure through the air migration pathway may occur for targets at Wendover AFAF.

For the HAFR, there are no known sensitive environments or resources located within 4 miles of the site. Thus, the likelihood of exposure at the HAFR would be expected to occur only to on-site workers and residents, and this exposure pathway is expected to result in a moderate likelihood of exposure.

Section 5
SITE EVALUATION AND SCORING

5.1 Wendover Air Force Auxiliary Field

All 18 sites evaluated at Wendover AFAF were scored in accordance with the HRS using the PREscore software. PREscore performs HRS calculations from raw data, calculates values from hazardous substance information, and calculates site scores. These scores are shown in Table 5-1.

The HRS is a method of evaluating the relative potential of hazardous substance releases to cause health or safety problems, or ecological or environmental damage. Decisions regarding whether or not a site requires either "further action" or "no further action" may be based on the results of HRS site scores. Generally, sites that score 28.5 or lower receive a no further action recommendation. The HRS scores for Wendover AFAF sites are all well below 28.5.

The scoring approach for the sites at Wendover AFAF was to incorporate available analytical data where possible and to make conservative assumptions where these data were not available. Most components of the model were evaluated quantitatively by determining areas of contamination, distances to receptors, and so forth. However, factors that relate to potential releases of hazardous substances from the site and the likelihood that specific targets may be exposed to released substances were evaluated by applying professional judgment.

The HRS site score is the result of an evaluation of four pathways:

- Groundwater migration (S_{gw});
- Surface water migration (S_{sw});
- Soil exposure (S_s); and
- Air migration (S_a).

The groundwater and air migration pathways use single threat evaluation, whereas the surface water migration and soil exposure pathways use multiple threat evaluations. The three threats evaluated for the surface water pathway are drinking water, human food chain, and environmental. These threats are evaluated for the overland and the groundwater to surface water migration components. The two threats evaluated for the soil exposure pathway are the resident population and the nearby population.

The site score is calculated with the following equation:

$$S = \sqrt{\frac{S_{gw}^2 + S_{sw}^2 + S_s^2 + S_a^2}{4}}$$

Common evaluations made for each pathway include: 1) characterizing sources; 2) scoring the likelihood of release (or likelihood of exposure for the soil pathway); 3) scoring the waste characteristics factor category; and 4) scoring the targets factor category.

Characterization of sources is determined on the basis of soil or groundwater contamination observed at a site. The hazardous substances associated with the sources included only those constituents detected during the field investigation. Characterizing the source also required determining all available migration (exposure) pathways for that source. The amount of the source was estimated by measuring the areal extent of the source from the map used to delineate the sites shown in Figure 3-1.

The likelihood of release is a measure of the likelihood that a waste has been or will be released to the environment. The likelihood of release factor category is assigned the maximum value of 550 whenever the criteria for an observed release are met for that pathway. The potential to release is calculated only if the observed release is not confirmed.

Waste characteristics are determined by the hazardous waste quantity; toxicity; and, as applicable, mobility, persistence, and/or bioaccumulation potential. These characteristics were calculated directly by PREscore based on hazardous substances detected at

Table 5-1

Summary of Results of Site Scoring
Wendover Air Force Auxiliary Field and Hill Air Force Range

Site	HRS Score[a]
B--Engineer Motor Pool Sump	0.16
BB--Atomic Warhead Storage Building	0.77
D--Old Fire Station Ditch	5.13
E--Post Salvage Yard	0.21
F--Fire Drill Pit	0.58
G--Hospital Area (cradle tanks)	0.52
K--Landfill Area	0.61
L--West Aircraft Drainage Ditch to Blue Lake	0.60
M--2600 Area Buildings	0.62
O--Paint Disposal Pit	0.90
OO--Paint Disposal Pit II	0.52
P--Hangar 1/Machine Shop	0.31
Q--Automotive Fuel Depot	0.39
R--Secondary Auto Fuel Shop	0.19
S--Fuel Dispensing Station	0.16
V--V-1 Rocket Launching Site	0.00
W--Sewage Treatment Plant	0.47
Z--Apron Area	3.94
HAFR[b]	14

[a]Site scores determined with the use of PREscore software, an electronic version of the Environmental Protection Agency Hazard Ranking System (HRS) model.

[b]Site score determined with the use of PA score software, an electronic version of the Environmental Protection Agency HRS model.

each of the sites.

The types of targets evaluated include individuals, human populations, resources (which vary by pathway), and sensitive environments. The factor values were assigned by PREscore based on identifying the different targets.

Information was collected to score each pathway. The surface water and groundwater pathways were not scored because of lack of receptors. For the soil pathway for 12 of the 18 sites, data were available from laboratory analyses of soil samples. This information was directly incorporated into the model. The results of field screening of groundwater samples only were available for the remaining six sites. These results were input as waste constituents, and the concentration was used directly, when available. If the concentration was listed as "trace" a value of 0.001 ppm was input into the model. For the air pathway, a potential release was calculated when soil contamination was detected in the upper 2 ft of soil at the site.

On the basis of identifying and inputting the types of information discussed above, scores were calculated for each of the 18 Wendover AFAF sites.

5.2 Hill Air Force Range

The HAFR site was scored using the PAscore software, which generates an upper value estimate of the HRS score for a site. The PAscore was used instead of the PREscore because no detailed analytical or sampling information was collected at the HAFR as part of the PA/SI.

The HRS score for the HAFR was calculated to be 14, as shown in Table 5-1. This is well below the score of 28.5, which generally results in a site receiving a further action recommendation.

The PAscore evaluates a site using the same four migration pathways as in the PREscore. The pathways include groundwater migration, surface water migration, soil exposure, and air migration. The score is also calculated with the same equation presented in Section 5.1. However, the data inputs are typically estimated and are less rigorous.

Characterization of sources was estimated on the basis of the various solid waste management units (SWMUs) known to exist at the HAFR, based on discussions with HAFR personnel. The SWMUs identified at the HAFR are presented in Table 2 (Summary of Findings). The SWMUs include landfills, spill areas, residue piles, pits, lagoons, and storage areas. These SWMUs were grouped into three basic contamination source types: contaminated soils, landfills, and surface impoundments.

The volumes of wastes placed into these SWMUs was unknown, so a surficial area of contamination for each source type was conservatively estimated at 100 acres, for a total of 300 acres of contaminated areas at the HAFR. The PAscore model is not very sensitive to this parameter and yields the same score when a total of 30 acres of contaminated area is used.

Waste characteristics are incorporated with the PAscore model assuming a worst-case scenario. These values are calculated by the model.

Targets were identified and input into PAscore in a similar manner as was done for the Wendover AFAF scoring. The PAscore then assigned factor values based on the numbers and types of targets. Because surface water exists and groundwater is used at the HAFR, all four pathways were scored. On the basis of identifying and inputting the types of information discussed above, an HRS score was calculated for the HAFR.

Section 6
RECOMMENDATIONS

On the basis of the HRS scores of the sites evaluated during the PA/SI, no further investigation is recommended. The highest HRS score for an individual site at Wendover AFAF is 5.13 (Site D), and the entire north range of the HAFR scored 14. HRS scores for all the sites evaluated are well below the score of 28.5, which is typically the score that, if exceeded, indicates that a site warrants further action.

No further investigation of potential soil contamination associated with any specific site at Wendover AFAF is recommended. Contaminant concentrations detected in soils during the PA/SI were compared with the proposed RCRA Subpart S action levels. The proposed action levels were used for comparison purposes only and are not intended for use as regulatory cleanup standards or as criteria for further investigation of soil contamination. Further investigation is recommended; however, to establish whether or not the concentrations of inorganic constituents (arsenic and beryllium) detected occur naturally in the soils.

No further investigation of groundwater quality is recommended since groundwater in the vicinity of Wendover AFAF is not used for drinking, and the potential for exposure through the groundwater pathway is nonexistent. Contaminants detected in groundwater during the PA/SI were compared with either Utah or federal MCLs. Groundwater quality in Utah is regulated under the Utah Groundwater Protection Rules. The groundwater in the vicinity of Wendover AFAF is unclassified groundwater (Whitehead, 1993). The levels of protection for unclassified groundwater will be determined by the existing groundwater quality (Utah Administrative Code, 1993). Groundwater in the Wendover area, if it were classified, would likely be designated as either Class III (Limited Use Groundwater) or Class IV (Saline Groundwater).

No further investigation of potential contamination is recommended for Site K (Landfill), located in the State of Nevada. No MCLs were exceeded in groundwater, with the exception of thallium detected in wells K-103 and 104. The only contaminants exceeding the proposed action levels in soils were arsenic and beryllium. As stated above, further investigation is recommended to establish whether or not the concentrations of these inorganic constituents occur naturally in the soils.

No further investigation is recommended for Site 20 (Ordnance Disposal Area), which was visually inspected at the request of the State of Nevada, Division of Environmental Protection for the presence of unexploded ordnance and hazardous materials. Neither of these substances was found to be present at the remote site.

The primary further action recommendations at Wendover AFAF are made with regard to continued civilian use and any future development plans at the Base. Civilian access to the majority of Wendover AFAF is unrestricted, and disturbance of soils or groundwater could result in human exposure to hazardous substances. It is recommended that any future development or construction-related activities that may either disturb the soil or result in contact with groundwater at Wendover AFAF proceed with caution. Appropriate environmental and health and safety controls should be used to monitor and minimize potential human exposure to hazardous substances during development activities. Remedial investigations may be warranted to develop exposure controls or remedial strategies in areas planned for future development. Development restrictions through appropriate zoning controls and land-use restrictions could alternatively be used to prevent potential human exposure to hazardous substances that may occur during development activities.

These measures to address potential exposure to hazardous substances at Wendover AFAF are particularly recommended for any development activities that may occur in the vicinity of Sites D, E, F, L, M, P, and Z. These sites were identified during the site investigation as being the most contaminated. Most of these sites are located in an area extending from Site E to Site L and generally between A Street and the aircraft apron. The majority of this area of Wendover AFAF is currently accessible to civilians and is used for commercial purposes.

It is recommended that any possible future development or construction-related activities associated with the proposed 1400-acre industrial park proceed with caution with the appropriate environmental and health and safety controls. The industrial park is proposed in an area that includes the old landfill, disturbance of which could result in human exposure to hazardous substances. Of particular concern would be the metal plating wastes reported to have been disposed of in the landfill. It should be noted that, although the groundwater and soils in the vicinity of the landfill were investigated as part of the PA/SI, the materials within the landfill were not characterized.

On the basis of the HRS score, no further investigation is recommended for the HAFR. It is recommended, however, that the U.S. Air Force continue its search, inventory, and characterization of SWMUs at the north range of the HAFR. This search and inventory of SWMUs at the HAFR is an ongoing activity of the U.S. Air Force and is being conducted under the jurisdiction of the Resource Conservation and Recovery Act.

Section 7
REFERENCES

1. Alexander, Thomas G. and Leonard J. Arrington, Fall 1963. *World's Largest Military Reserve: Wendover Air Force Base 1941-63.* Vol. 31, No. 4.

2. Bedinger, M.S., K.A. Sargent, and W.H. Langer, 1990. *Studies of Geology and Hydrology in the Basin and Range Province, Southwestern United States, For isolation of High-Level Radioactive Waste-Characterization of the Bonneville Region, Utah and Nevada.* U.S. Geological Survey Professional Paper 1370-G.

3. Craner, Gene, 11 November 1992. *Questionnaire for Personnel Interviews Wendover Air Force Auxiliary Field.* Personal Communication.

4. Dickman, Duane, 18 November 1993. *Questionnaire for Personnel Interviews Hill Air Force Range.* Personal Communication.

5. Earth Technology Corporation, The, August 1992. *Defense Environmental Restoration Program Formerly Used Defense Sites, Inventory Project Report, Wendover Air Force Auxiliary Field, Tooele County, Utah, Site No. J09UT100180.*

6. Housley, Kelly, November 1993. Wendover USA Visitor & Convention Bureau. Personal Communication.

7. Jensen, Mark, November 1993. Utah Division of Drinking Water. Personal Communication.

8. National Oceanic and Atmospheric Administration. *Daily Normals of Temperature, Precipitation and Heating and Cooling Degree Days, 1961-1990.* Climatography of the United States No. 84, Utah, Wendover.

9. Office of the Federal Register, 1 July 1993. 40 CFR 300, Appendix A: *The Hazard Ranking System.*

10. Radian Corporation, May 1993. *Final Work Plan for Preliminary Assessment Site Investigation. Wendover Air Force Auxiliary Field and Hill Air Force Range.* Salt Lake City.

11. Scobie, Bob, 5 November 1992. *Questionnaire for Personnel Interviews Wendover Air Force Auxiliary Field.* Personal Communication.

12. Title 40 Code of Federal Regulations, Part 141 - National Primary Drinking Water Regulations, 1989.

13. Title 40 Code of Federal Regulations - National Contingency Plan, revised 1 July 1990.

14. U.S. Department of Commerce, 1961. *Rainfall Frequency Atlas of the United States.* Technical Paper No. 40.

15. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, January 1992. *Monthly Station Normals of Temperature, Precipitation, and Heating and Cooling Degree Days 1961-90.* Climatography of the United States No. 81, Utah.

16. U.S. Environmental Protection Agency, July 1990. *Proposed RCRA Subpart S Action Levels*, 55 Federal Register 30798-30884.

17. U.S. Environmental Protection Agency, September, 1991. *PA-Score Software Users Manual & Tutorial.* Version 1.0.

18. U.S. Environmental Protection Agency, September 1991. *Guidance for Performing Preliminary Assessments Under CERCLA.* Publication 9345.0-01A.

19. U.S. Environmental Protection Agency, September 1992. *Guidance for Performing Site Inspections Under CERCLA.* Interim Final.

20. U.S. Environmental Protection Agency, November 1992. *Hazard Ranking System Guidance Manual.*

21. U.S. Environmental Protection Agency, May, 1993. *PREscore Software Users Manual and Tutorial.* Version 2.0.

22. U.S. Geological Survey, 1979. *Bonneville Salt Flats, Utah Topographic Map.*

23. U.S. Geological Survey, 1985. *Wendover Utah and Nevada Topographic Map.*

24. U.S. Geological Survey, 1987. *Promontory Point, Utah Topographic Map.*

25. U.S. Geological Survey, 1988. *Newfoundland Mountains, Utah Topographic Map.*

26. United States Department of Agriculture, April 1986. *Air Force Base, Utah Soil and Range Survey.*

27. Utah Administrative Code, R317-6, April 1993. *State of Utah Ground Water Quality Protection Rules.*

28. Utah Division of Water Rights, 10 November 1993. *Water Right Point of Diversion Plot for Wendover.*

29. Utah Division of Water Rights, 10 November, 1993. *Water Right Point of Diversion Plot for Hill Air Force Range.*

30. Wadsworth, Glen, November 1993. Reilly Industries. Personal Communication.

31. Weider, Dennis, 18 November 1993. *Questionnaire for Personnel Interviews Hill Air Force Range.* Personal Communication.

32. Wheeler, Margaret L., November 1933. City of Wendover, State of Utah. Personal Communication.

33. Whitehead, John, October 1993. Utah Division of Water Quality. Personal Communication.

'AN CORPORATION
\USTIN, TEXAS

WENDOVER AIR FORCE
AUXILIARY FIELD

A

.IN

R.FARNEY

PLATE 1
CONE PENETROMETER TESTING AND SOIL GAS AND GROUNDWATER SCREENING LOCATIONS, WENDOVER AIR FORCE AUXILIARY FIELD

ER

RP.
-gineer

Scale: As Shown	Sheet reference number: 1/4	Date: NOV. 16, 1993
Spec. No.:		Drawing Code: B10616 12.13.93
Contract No.: F42650-92-D-0007/5002		

1

N CORPORATION JSTIN, TEXAS	WENDOVER AIR FORCE AUXILIARY FIELD

A

FARNEY	PLATE 2 BOREHOLE AND SURFACE SOIL SAMPLING LOCATIONS, WENDOVER AIR FORCE AUXILIARY FIELD		
	Scale: As Shown	Sheet reference number:	Date: NOV. 8,1993
	Spec. No.:		Drawing Code:
ineer	Contract No.: F42650-92-D-0007/5002	2/4	B10604A 12.13.93

1

AN CORPORATION JSTIN, TEXAS	WENDOVER AIR FORCE AUXILIARY FIELD

A

N .FARNEY	PLATE 3 GROUNDWATER SAMPLING LOCATIONS AND GROUNDWATER CONTOURS, WENDOVER AIR FORCE AUXILIARY FIELD		
R	Scale: As Shown	Sheet reference number:	Date: NOV. 30, 1993
	Spec. No.:	3/4	Drawing Code:
P. gineer	Contract No.: F42650-92-D-0007/5002		B10624 12.13.93

1

| CORPORATION
STIN, TEXAS

WENDOVER AIR FORCE
AUXILIARY FIELD

A

ARNEY

PLATE 4

IMPACTS TO SOIL AND GROUNDWATER
WENDOVER AIR FORCE AUXILIARY FIELD

Scale: As Shown	Sheet reference number: 4/4	Date: NOV. 8,1993
Spec. No.:		Drawing Code: B10604 02.08.94
Contract No.: F42650-92-D-0007/5002		

eer

1

Reference 5

Ref 5

OGDEN AIR LOGISTICS CENTER

Hill Air Force Base, Utah

Draft

Work Plan For Preliminary Assessment Site Investigation

Wendover Air Force Auxiliary Field Utah Test and Training Range

January, 1993

RADIAN CORPORATION

RCN: 279-102-01-01

DRAFT

WORK PLAN FOR PRELIMINARY ASSESSMENT/SITE INVESTIGATION WENDOVER AIR FORCE AUXILIARY FILED UTAH TEST AND TRAINING RANGE

JANUARY 15, 1993

PREPARED BY:

RADIAN CORPORATION
4021 S. 700 East, Suite 600
Salt Lake City, UT 84107

USAF CONTRACT NO. F42650-92-D007,
Delivery Order 2

MR. SHANE HIRSCHI
USAF PROJECT MANAGER
OGDEN AIR LOGISTICS CENTER/ENVIRONMENTAL MANAGEMENT

TABLE OF CONTENTS

Page

1.0 INTRODUCTION 1-1

2.0 BACKGROUND 2-1

2.1 Location and General Description of Base Activities 2-1
2.2 Previous Work and Site Specific Background Information 2-3

3.0 ENVIRONMENTAL SETTING 3-1

3.1 Geographical Setting 3-1
3.1.1 Physiography 3-1
3.1.2 Topography 3-2
3.2 Geology 3-2
3.3 Hydrology 3-3
3.3.1 Surface Water 3-3
3.3.2 Groundwater 3-4
3.3.3 Water Use 3-4
3.4 Climatology 3-5
3.5 Human Environment 3-5
3.5.1 Population and Demographics 3-6
3.5.2 Land Use 3-6

4.0 SCOPE OF WORK 4-1

4.1 Organization of Effort 4-1
4.1.1 Site Selection 4-1
4.1.2 Field Sampling 4-14
4.2 Site Evaluation Tasks 4-14
4.2.1 Field-Related Tasks 4-15
4.2.2 Environmental Sampling Procedures 4-30
4.2.3 Recordkeeping 4-35
4.2.4 Field QA/QC Program 4-39
4.2.5 Site Management 4-40
4.3 Evaluation-Related Tasks 4-40
4.4 Project Organization 4-43
4.4.1 Roles and Responsibilities 4-43

5.0 QUALITY ASSURANCE/QUALITY CONTROL 5-1

5.1 Introduction 5-1
5.2 Project Description 5-1
5.3 Data Quality Objectives 5-2

Table of Contents
(Continued)

5.3.1 Quality Control Procedures 5-2
5.3.2 Quality Assurance Audits 5-3
5.3.3 Analytical Capability 5-7
5.4 Field Procedures 5-12
5.5 Sample Custody 5-20
5.5.1 Chain of Custody 5-20
5.5.2 Documentation 5-26
5.5.3 Sample Handling, Packaging, and Shipping 5-28
5.6 Calibration Procedures 5-32
5.6.1 Field Calibration Procedures 5-33
5.6.2 Laboratory Calibration Procedures 5-35
5.7 Analytical Procedures 5-41
5.7.1 Inorganic Analyses 5-42
5.7.2 Organic Analyses 5-45
5.7.3 Toxic Characteristic Leaching Procedure (TCLP) 5-47
5.7.4 General Parameters 5-47
5.7.5 Geotechnical Analyses 5-48
5.8 Data Reduction, Validation, and Reporting 5-48
5.8.1 Data Reduction 5-50
5.8.2 Data Quality Review 5-50
5.8.3 Reporting 5-54
5.9 Internal Quality Control 5-54
5.9.1 Analytical Quality Control 5-55
5.9.2 Field Quality Control 5-77
5.10 Preventative Maintenance 5-78
5.10.1 Maintenance Responsibilities 5-79
5.10.2 Maintenance Schedules 5-80
5.10.3 Spare Parts 5-80
5.11 Assessment of Precision, Accuracy, and Completeness 5-83
5.11.1 Precision and Accuracy 5-83
5.11.2 Blanks 5-84
5.11.3 Completeness 5-85
5.12 Corrective Action 5-85
5.13 Quality Assurance Reporting 5-87
5.13.1 Quality Assurance Reporting 5-87
5.13.2 Quality Control Data Reporting 5-88

6.0 REPORTING REQUIREMENTS 6-1

7.0 REFERENCES 7-1

LIST OF TABLES

		Page
4-1	Prioritization of Sites within Study Areas	4-2
4-2	Study Sites and Sample Numbers	4-4
4-3	Field Tasks, PA/SI for Wendover/UTTR, Utah	4-16
5-1	Estimated Precision and Accuracy Objectives for Groundwater Samples	5-8
5-2	Estimated Precision and Accuracy Objectives for Soil Samples	5-10
5-3	Analytical Methods, Requested Detection Limits, and Maximum Contaminant Levels	5-13
5-4	Summary of Water Sampling and Analysis Requirements	5-29
5-5	Summary of Soil and Sediment Sampling and Analysis Requirements	5-31
5-6	Summary of Internal Quality Control Procedures	5-56
5-7	Instrument Maintenance Schedule	5-81

LIST OF FIGURES

		Page
2-1	Location of Wendover Air Force Auxiliary Field, Utah	2-2
2-2	Sites of Concern in the Wendover AFAF Area, Utah	2-5
4-1	Area 1 and Proposed Sampling Locations, Wendover AFAF, Utah	4-6
4-2	Area 2 and Proposed Sampling Locations, Wendover AFAF, Utah	4-7
4-3	Area 3 and Proposed Sampling Locations, Wendover AFAF, Utah	4-8
4-4	Area 4 and Proposed Sampling Locations, Wendover AFAF, Utah	4-9
4-5	Area 5 and Proposed Sampling Locations, Wendover AFAF, Utah	4-11
4-6	Area 6 and Proposed Sampling Locations, Wendover AFAF, Utah	4-12
4-7	Area 7 and Proposed Sampling Locations, Wendover AFAF, Utah	4-13
4-8	Wendover/UTTR Project Team Organization Chart	4-44
5-1	Radian Sample Label	5-22
5-2	Chain of Custody Form	5-23
5-3	Radian Custody Seal	5-24
5-4	Master Sample Log	5-27
5-5	Data Reporting Scheme	5-49

1.0 INTRODUCTION

Hill Air Force Base (HAFB) Environmental Management and Restoration (EMR) is conducting a Preliminary Assessment/Site Investigation (PA/SI) at Wendover Air Force Auxiliary Field (AFAF) and the Utah Test and Training Range (UTTR). The UTTR is defined here as all areas outside the AFAF where bombing, gunnery target practice, or the disposal of live or potentially live ordnance has occurred. The purpose of the investigation is to evaluate installation areas where past activities have had a potential negative impact on the environment and where further study may be indicated.

To identify sites of potential contamination at Wendover AFAF, the PA/SI effort includes record searches, personal interviews of former employees, and soil and groundwater sampling and analysis to identify the type of potential contaminants. During the record search and personal interviews, 25 sites were identified at the Wendover AFAF that warrant soil or groundwater sampling. Presently, environmental sampling is proposed only at the Wendover AFAF area sites. Because of the size of the area (more than 7 million acres) and the potential presence of explosives, the UTTR PA includes further records searches and personal interviews, but no invasive sampling or testing. Further identification of the potentially contaminated sites at the UTTR is beyond the scope of this project.

This Work Plan addresses the proposed environmental work specified under HAFB Statement of Work (Contract F42650-92-D0007, Delivery Order No. 5002). The plan provides all the information needed for conducting the PA/SI by describing the background of the installation and the environmental setting; the proposed field work, site sampling and analytical techniques, and the evaluation and reporting of the hydrogeologic and analytical data. Additionally, the laboratory quality assurance procedures are discussed in detail.

2.0 BACKGROUND

2.1 Location and General Description of Base Activities

Wendover Air Force Auxiliary Field (AFAF) is located east of the Utah/Nevada border, just south of the City of Wendover, Utah. Wendover, Utah is located approximately 130 miles west of Salt Lake City, Utah and 110 miles east of Elko, Nevada (Figure 2-1). The AFAF site is bounded by the City of Wendover and Interstate 80 to the north, vacant land to the west and south, and by a large evaporation pond area to the east.

Parts of Wendover AFAF are currently owned by the City of Wendover, Department of the Interior (Bureau of Land Management), Department of the Air Force, Department of Transportation, Federal Aviation Administration, and several private parties. The total Wendover AFAF area is approximately 96,997 acres. The Wendover Airport occupies approximately 2,000 acres of the site. Approximately 110 government-constructed buildings exist at Wendover AFAF, of which 31 are occupied by various private and public tenants.

Site History

Wendover Air Force Base (AFB) was originally conceived and constructed as part of a massive Air Force expansion program in 1941. The basic mission during World War II was for training of air bombardment groups. In 1944, additional missions included the training of B-29 pilots and the construction and loading of the first atomic bombs, and the testing and development of early guided missiles (V-1, V-2).

After the war and until 1954, the use of the base and adjacent ranges was primarily for practice bombing. By 1957, the Utah National Guard used the Wendover AFB area for mock recoveries and occasional gunnery training. The base was officially deactivated in December 1960, but reactivated as Wendover AFAF in July, 1961. As an auxiliary base, the base and adjacent ranges, including the Utah Test and Training Range (UTTR, approximately

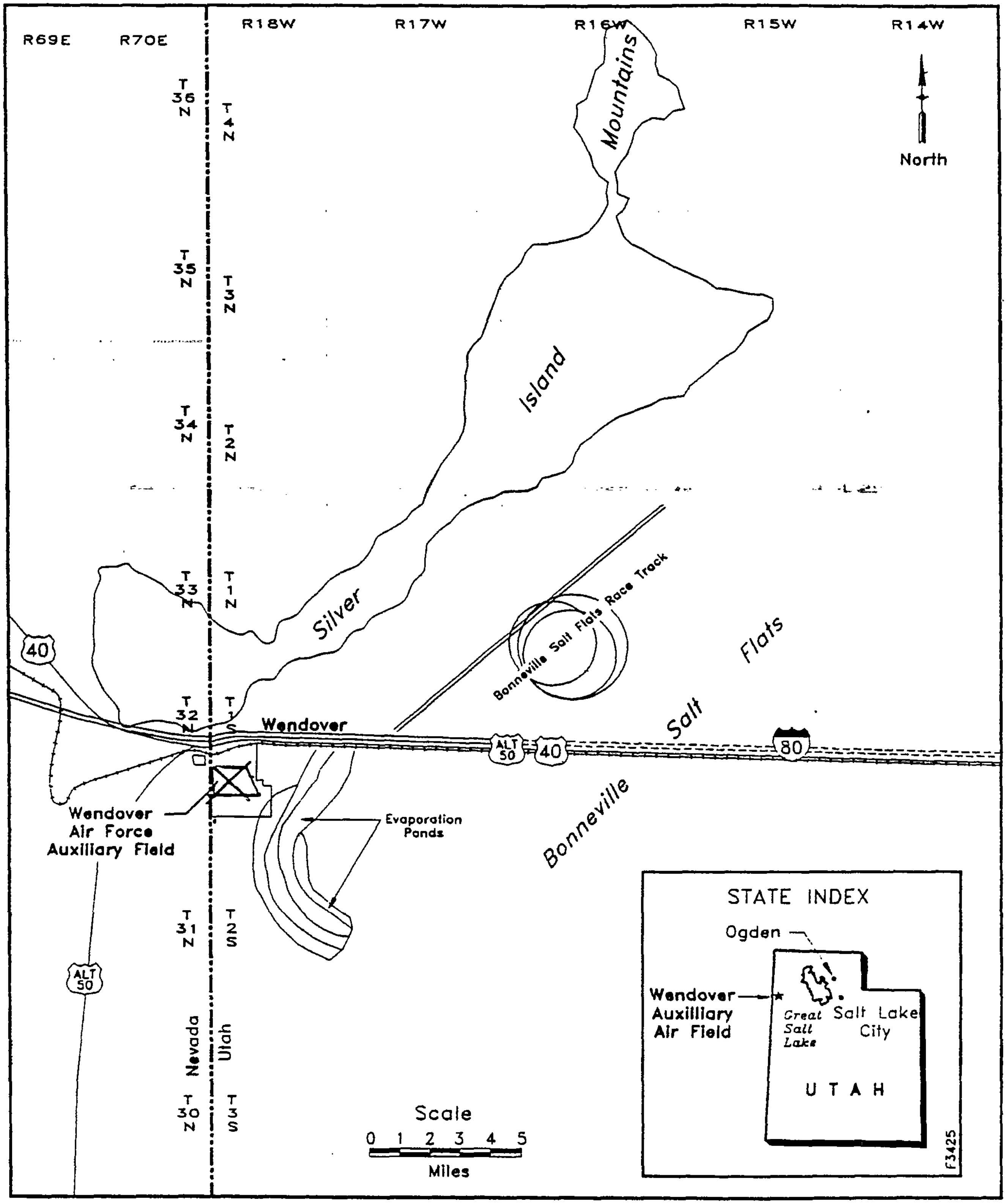


Figure 2-1 Location of Wendover Air Force Auxiliary Field, Utah

50 miles east of Wendover) used for various munitions testing. The Air Force presently uses the Wendover property as a radar tracking and search facility. The radar site was constructed in the late 1970's.

Currently at Wendover AFAF, the Air Force occupies 157.4 acres on the east side of the former Wendover AFB cantonment area. This property is bordered by 11th Street to the west, Union Pacific Railroad tracks to the north, A Street to the south, and open salt flats to the east. The Wendover Airport is operated by Nevada Aviation Service, Inc. which provides hangar space and fueling to private and military clients. Aviation fuel is stored on site in above ground tanks, located west of Building 412, that have a total capacity of approximately 56,000 gallons.

2.2 Previous Work and Site Specific Background Information

The Earth Technology Corporation (ETC, 1992) recently conducted an inventory of sites of potential environmental concern at Wendover AFAF for the Army Corps of Engineers, Sacramento District. The inventory was conducted under the Defense Environmental Restoration Program, Formerly Used Defense Site (DERP-FUDS). In their site inventory, ETC conducted extensive records searches and personal interviews and identified 20 potential environmental sites at Wendover AFAF categorized by potential hazards. The majority of the sites were classified as eligible for DERP-FUDS funding, while a small number are ineligible because of non-Department of Defense (DOD) beneficial use or current DOD property ownership. Radian Corporation (1992) conducted interviews of former base employees with knowledge of past waste handling and disposal practices. The information from the former employees corroborated the data from ETC (1992) and also identified other sites needing sampling.

There are four previously unsampled sites on current DOD property at Wendover identified by the ETC study that have potentially impacted the environment and warrant further investigation. Figure 2-2 identifies the general location of the DOD property sites and other areas comprising groups of sampling sites. The following paragraphs describe the current DOD property sites scoped for environmental study:

- Former Base Landfill (Area 1) -- Located on Air Force property in Nevada, the landfill is approximately 0.75 miles west of the Utah-Nevada border and approximately 0.25 miles south of Highway 93. The landfill is estimated to cover 100 acres and is 10 to 12 feet thick. The landfill was used from the 1940's until 1975 by the military, City of Wendover and Elko County, Nevada. According to interviewed personnel, all types of non-explosive debris have been disposed in the landfill, including construction rubble, plating mill wastes, and possibly spent solvents and fuels. Probable contaminants include various metals, asbestos, and petroleum products.

- V-1 Rocket Launch Site (Area 2) -- The V-1 Rocket Launch Site is located approximately 0.5 miles south of the airport runway area. The site was used in 1945 to test launch V-1 Buzz Bombs. Discarded metal debris, including spent fuel canisters, are present on the ground at the site and immediately to the east, however, no evidence of stained soil exists in the area. Potential contaminants include petroleum hydrocarbons and heavy metals.

- Post Engineer Salvage Yard (Area 3) -- The former salvage yard is located in the vicinity of the current Air Force radar station and reportedly received salvaged metal, transformers, and other debris. The salvage yard measured approximately 700 feet by 350 feet and was used by the military from the early 1940's until about 1960. In the 1970's, the military moved the majority of the salvage debris to a location between 13th and 14th Streets, and A and B Streets, and in 1984, the debris was removed from Air Force property. Potential contaminants include volatile organic compounds, polychlorinated biphenyls (PCBs), and petroleum hydrocarbons.

- Former Fuel Dispenser (Area 7) -- A former gas dispensing station reportedly active in the 1940s is located near the intersection of 11th and B Streets. The concrete remains of a fuel dispensing island are noticeable in the area. About 20 feet to the north of the concrete island is a surface depression that is suggestive of an excavated UST location. Whether the UST has been removed or not is presently unknown. Potential contaminants include petroleum hydrocarbons.

RADIAN CORPORATION

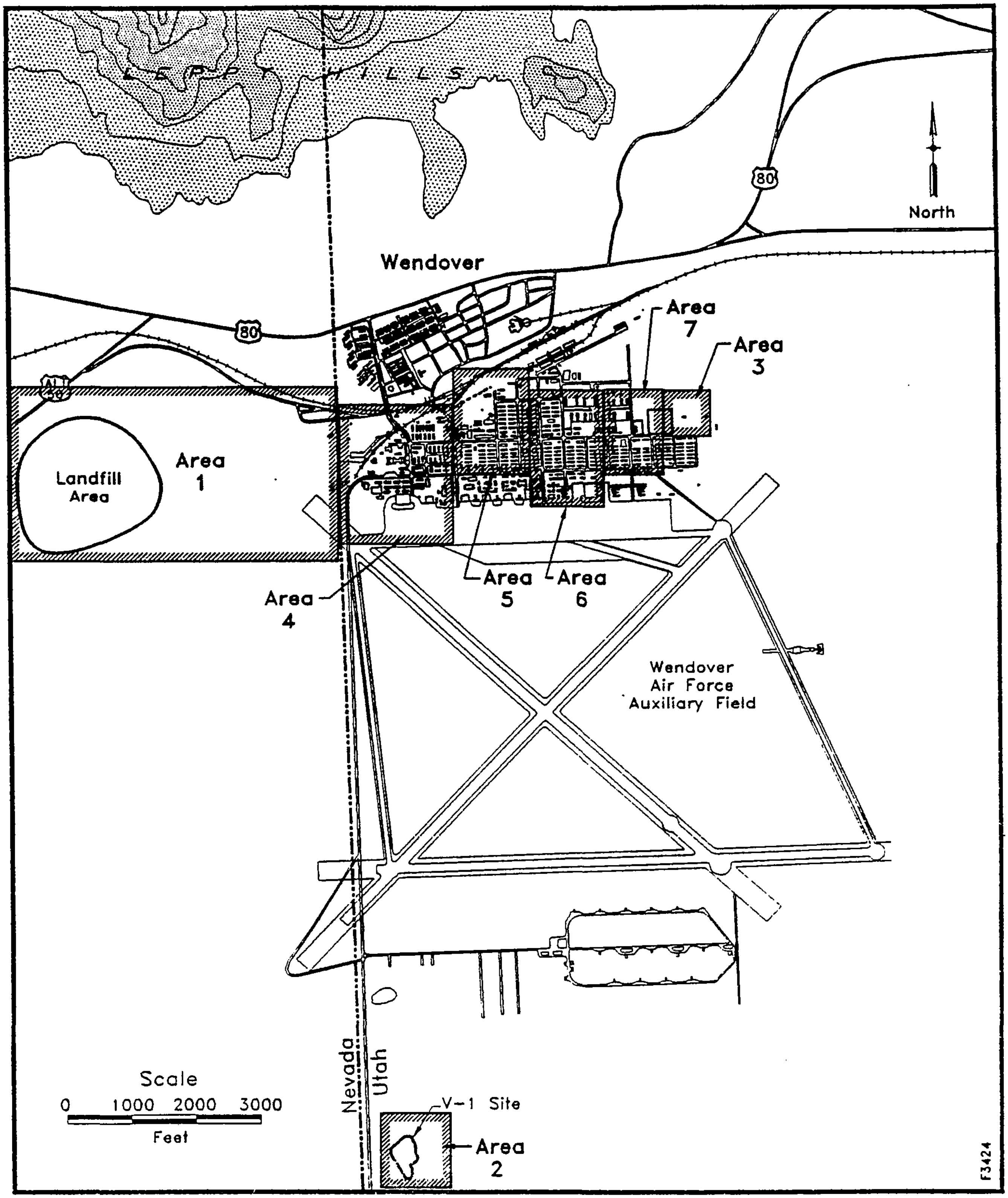


Figure 2-2 Sites of Concern in the Wendover AFAF Area, Utah

In addition to the above sites, the ETC study and Radian interviews (1992) have identified areas where former Air Force activities may have contributed to soil and groundwater contamination. The majority of these sites are located within the former Wendover AFAF cantonment and many are adjacent to the above identified sites. These sampling areas will be prioritized according to the rationale presented in Section 4.0 and sampled along with the four sites mentioned above.

3.0 ENVIRONMENTAL SETTING

This section describes the general environmental setting of the Wendover AFAF area, including the geography, geology, hydrology, climatology, and the human environment. Information from a variety of sources was used in this section.

3.1 Geographical Setting

Wendover AFAF is located in extreme western Utah approximately 130 miles west of Salt Lake City and 110 miles east of Elko, Nevada. The city of Wendover is actually bisected by the Utah/Nevada state line. The majority of the study sites are located south of the City of Wendover in Tooele County, Utah; however, the landfill is located west of the state line, in Wendover, Nevada.

The Wendover study area is south of the Leppy Hills of the Silver Island Mountain Range on the western edge of the Great Salt Lake Desert. The northern perimeter of the site is bounded by the City of Wendover and Interstate 80. The eastern, western and southern perimeters are bounded by vacant salt flats and playas. The geographic setting of the Wendover AFAF is illustrated on Figures 2-1 and 2-2.

3.1.1 Physiography

The Wendover AFAF is located in the Bonneville region of the northeastern section of the Basin and Range province. The region consists of linear, north-trending mountain ranges separated by valleys and closed basins (Bedinger, et al, 1990). Relief between the valleys and adjacent mountains is from 3,000 to 6,000 feet. Mountainous areas cover approximately one-third of the region, with the highest elevation being Wheeler Peak (13,067 feet) in the Snake Range of Nevada. Rock debris shed from the mountains is present in broad alluvial fans which coalesce into the basinal salt flat areas. The fans are more pervasive in the Bonneville region than in the more mountainous parts of the Basin and Range province.

3.1.2 Topography

Wendover AFAF is on salt flat and playa deposits of Lake Bonneville, the ancestor of the Great Salt Lake. Surface elevation varies little across the Wendover site. The surface elevations at Wendover AFAF vary from a low of approximately 4,218 feet above mean sea level (AMSL) in the area of the V1 Launch Site to approximately 4,250 feet (MSL) in the area of the Salvage Yard. The Leppy Hills, with elevations over 6,000 feet, are located to the north of the site.

3.2 Geology

In general, the Wendover area is situated within the Bonneville Sector of the Basin and Range geologic province, on the western edge of lake fill sediments that onlap faulted and tilted Paleozoic bedrock and colluvium (Bedinger et al, 1990; USGS, 1988(a)).

The Leppy Hills to the north of the site area are characterized by complexly faulted and folded Paleozoic rocks that have been locally intruded by Mesozoic and Tertiary igneous plugs. Sedimentation throughout most of the Paleozoic in the site area was controlled by the pattern of late Precambrian rifting along the western margin of the North American continent (Stewart, 1972). Locally at Wendover, bedrock outcrops occur in the northwest corner of the Wendover AFAF area. Based on site reconnaissance, the depth to the bedrock beneath the lake fill sediment probably ranges to several hundred feet, becoming deeper farther to the south and east.

The Wendover AFAF site area is characterized by basin fill deposits consisting mainly of nonindurated to semi-indurated sedimentary terrestrial and lacustrine deposits from the ancient Lake Bonneville. The ages of the deposits range from Tertiary to Quaternary. The terrestrial deposits consist mostly of poorly sorted to moderately sorted combinations of gravel, sand, silt, and clay that were derived from the rocks in the mountains to the north. The basin fill also contains fine-grained lacustrine, carbonate and evaporite deposits.

3.3 Hydrology

The Wendover AFAF area is located along the edge of the Great Salt Lake Basin groundwater discharge zone. In this area, regional groundwater flow within the lake bed sediments is toward the surface, where it is evaporated.

Locally, the major source of recharge to the shallow groundwater system in the Wendover AFAF area is by slow downward infiltration of precipitation through the lake bed sediments. Groundwater at depth, however, is most likely recharged by mountain precipitation which enters bedrock fractures and flows downgradient and eventually enters the lake bed or by runoff into alluvial or colluvial sediments flanking the mountain ranges and interfingering with the basinal lake sediments.

In the Salt Lake Basin, there is regional discharge of groundwater to the surface where it is evaporated, leaving salt deposits. Locally in vegetated areas, there is also water lost to the atmosphere by evapotranspiration.

3.3.1 Surface Water

Surface water is present in the Wendover AFAF area only during brief episodes; all streams hold water intermittently depending on snow melt or occasional storms. During heavy rainfall, sheet flooding may originate in the Leppy Hills area, however, the majority of the runoff infiltrates into the unconsolidated sediments before it flows onto the lake bed sediments. In the Wendover AFAF area, occasional summer thunderstorms may produce flash flooding concentrating water in channels or gullies. Evaporation basins cover a large area in salt flats southeast of the site area and were built where the groundwater table is near ground surface.

3.3.2 Groundwater

The basin fill is the major surficial hydrogeologic unit in the Wendover AFAF area. Groundwater occurs within the basin fill in shallow unconfined units and, at depth, within confined aquifer units. Carbonate rocks consisting of massive to thinly bedded limestones and dolomites with silty and sandy interbeds represent a secondary hydrogeologic unit. The carbonate rocks range in thickness from about 500 to 25,000 feet. Regional transmittal of groundwater occurs from the carbonate rocks to the upper lake sediment aquifer.

Depth to water in the site area ranges from near ground surface to 50 feet below ground surface. The general hydraulic conductivity of the basin fill deposits is 2.0 E-02 meters/day (2.3 E-05 cm/sec; Bedinger, et al, 1990). From studies in other basin areas, typical hydraulic gradients in the basin fill deposits are extremely flat at approximately 0.005 meters per meter. Groundwater flow direction in the site area is generally to the southeast.

Water quality is characterized by dissolved solids and chemical constituents in solution. The concentration of dissolved solids ranges from less than 500 mg/L to 200,000 milligrams per liter. The major chemical constituents in the groundwater are calcium, magnesium, and sodium bicarbonate. The groundwater with higher dissolved solids typically has chloride as the prime anion.

3.3.3 Water Use

The State of Utah, Division of Water Rights was contacted concerning water use in the Wendover AFAF area. A Water Right Point of Diversion Plot created on December 21, 1992, indicated that four points of diversion exist within a 15,500 foot radius of the center of the Wendover AFAF. The four points of diversion are wells and springs owned by Reilly Industries, Inc. The points of diversion owned by Reilly Industries are located mostly north and east of the Wendover AFAF.

The water rights search indicated that no private or public drinking water wells were located within a 15,500 foot radius of the Wendover AFAF. Drinking water for the City of Wendover, Utah, is piped from springs about 30 miles to the north in the Pilot Mountains. This water is piped into a million-gallon reservoir located in the Wendover (UT) city limits. Wendover, Nevada, obtains drinking water from Johnson springs, about 25 miles west of Wendover in the Goshute Mountains.

3.4 Climatology

The climate of the Wendover AFAF is characterized as arid. The mean annual precipitation recorded during the period 1950 to 1976 is 4.87 inches, including mean annual snowfall of 8.1 inches (OL-A, USAFETAC, 1991).

Weather systems in the area are mostly controlled by continental storms in the winter; however, these storms rarely affect the area in the summer. The summer precipitation is essentially the result of thunderstorms.

Temperatures in the area can vary from the low one hundreds in the summer to below zero in the winter. Over the twenty six-year period from 1950 to 1976, the maximum and minimum temperatures recorded at Wendover AFAF were 105 degrees F and -10 degrees F, respectively.

3.5 Human Environment

Wendover AFAF is an open installation located south of the communities of Wendover, Utah and Wendover, Nevada. No known contamination has been detected or quantified on the Wendover AFAF. Community exposure and environmental concerns relating to the Wendover AFAF site are minimal.

3.5.1 Population and Demographics

The population within a four mile radius of Wendover AFAF is approximately 3,134, according to the 1990 Census. Of this total, 723 persons are children under the age of ten and 17 are adults over the age of seventy-five.

3.5.2 Land Use

The land use in the Wendover city area is approximately 70% commercial and 30% residential. Commercial concerns include motels/hotels, casinos, and various support services. The majority of the land in the Wendover AFAF area is presently vacant, however, some former buildings are presently used as businesses. The vacant land around the former cantonment area is unused and consists of playa and salt flats.

4.0 SCOPE OF WORK

4.1 Organization of Effort

The areas of focus during this Preliminary Assessment/Site Investigation (PA/SI) program at the Wendover/Utah Test and Training Range encompasses four previously identified sites on current Air Force property. These sites include the Old Base Landfill, the V1 Rocket Launching Site, the Post Salvage Yard, and the Fuel Dispensing Station. The Wendover and Utah Test and Training Range (UTTR) areas have been combined for this PA/SI due to their proximity to each other, however, environmental sampling will only be performed at the Wendover AFAF sites. Also, other Wendover AFAF sites identified from the ETC report (1992) and Radian interviews will be sampled on a prioritized basis.

4.1.1 Site Selection

Information from the interviews of former Wendover personnel and from the ETC report (1992) was used to identify the sites which will be investigated in this PA/SI for Wendover AFAF.

A total of 36 potential sites were identified. not including the UTTR area and other sites off the Wendover AFAF. These sites are prioritized for sampling (Table 4-1) on the following basis:

- Sites located on Air Force property were given the highest rating, a Priority 1. In addition, the four sites identified in the Scope of Work (described in Section 2.0) for this project were also assigned Priority 1. The four areas include the Old Base Landfill, the V-1 Rocket Launch site, the Post Salvage Yard, and the Fuel Dispensing Station at 11th and B Street;

Table 4-1

Prioritization of Sites within Study Areas

	WENDOVER AFAF PA/SI SITES			
	PRIORITY	AREA	ID No.	SITE
NV	1	1	K	Landfill (plating wastes, etc.) ETC SITE 12
NV/UTAH BORDER	1	2	V	V-1 Rocket Launching Site
	1	3	9	Signal tower (2238)
	1	3	E	Post Salvage Yard
	1	7	S	Fuel dispensing station - (11th and B)
	1	7	F	Fire drill pit (1 blk west of Range control office)
NV/UTAH BORDER	2	4	J	UST POL area (west side of cantonment) ETC SITE 8 & 7
	2	4	W	Sewage Treatment Plant
	2	4	P	Building 111 machine shop (solvent, fuel storage, paint booths)
	2	5	H	Dispensing station (UST still in ground at 5th and C)
	2	5	Q	Automotive fuel depot (bldg 1023)
	2	6	M	2600 area buildings (storage of solvents, herbicides)
	2	7	O	Paint disposal pit (northeast of building 2636)
NV/UTAH BORDER	3	4	L	West airfield drainage area (ditch to Blue Lake)
	3	4	C	Motor fuel tank (bldg north of present airport mgr office)
	3	4	A	Hanger 1 debris area - Low
	3	4	B	Engineer motor pool sump box (drive-over pit)
	3	5	18	Wash and grease racks (1013/1014)
	3	5	14	Motor vehicle repair shops (1025/1027)
	3	6	D	Old fire station (bldg 1800) motor pool ditch
	3	6	G	Hospital area (cradle tanks)
	3	6	R	Building 2609 - secondary auto fuel shop
NV	4	N/A	17	Sewer system (west) ETC SITE 17
	4	N/A	16	Sewer system (east)
NV/UTAH BORDER	4	4	10	Storage shed (428)
	4	4	15	Power plant (207)
	4	4	13	Electric switch/generator building (427/430)
	4	4	3	Alert building
	5	N/A	2	Wendover bombing and gunnery range
	5	N/A	N	Transformer oil burn pits (UTTR)
	5	N/A	21	Special weapons bombing range (8 miles north of Wendover)
NV	5	N/A	20	Ordnance disposal areas (4 miles SW of Wendover)
	5	N/A	T	Ordnance pits at UTTR
	5	2	U	Minuteman motor burn pits
	6	N/A	1	Atom bomb loading pits
	6	N/A	19	Atom bomb assembly plants

Area = Study Area for WAFAF

ID No = Identifiacation Corresponding to ETC Report or Interviews

- Priority 2 was allocated to sites not located on Air Force property, but identified by ETC (1992);

- Priority 3 was assigned to sites not identified or inventoried by ETC;

- Priority 4 was assigned to sites covered or funded under the Formerly Used Defense Sites (FUDS);

- Priority 5 was assigned to sites which involve possible ordnance disposal areas, or areas where possible unexploded ordnance may be present. They include the UTTR, Special Weapons Bombing Range, and other sites not directly associated with the Wendover AFAF. These sites will be investigated for preliminary assessment only; that is, no invasive testing of soil or groundwater will be performed at this time; and

- The lowest priority, Priority 6, was assigned to those sites considered to be clearly outside the scope of work for this project. These sites include the atom bomb assembly plant, and atom bomb loading pit areas.

The relative priorities of the various sites were then reassessed for the likelihood of contamination being present. Thus, the priorities of areas such as the fire training pit area and some of the gasoline storage and motor vehicles service areas were upgraded because the likelihood of contamination being present is relatively high.

Table 4-1 reflects the final priorities assigned to the sites. The area column refers to the Study Area which the site is located. The ID Number (or letter) represents a site which was identified from the ETC (1992) report or from the Radian interviews. The original identifier used in those documents will be referred to in the Project Report, and was retained in this work plan to avoid future confusion. Table 4-2 also lists the tentative number of Hydropunch/Cone Penetrometer (HP/CPT) test and groundwater monitoring

Table 4-2

Study Sites and Sample Numbers

WENDOVER PA/SI SITE SAMPLES					
SITE	AREA	ID No *	PRIOR.	No of HP/CPTs	No of MWs
NV Landfill ETL SITE 12	1	K	1	30	4
NV/UT Border V-1 Rocket Launching Site	2	V	1	11	0
Signal tower (2238)	3	9	1	2	1
Post Salvage Yard	3	E	1	13	0
UST POL area	4	J	2	8	3
Sewage Treatment Plant	4	W	2	3	0
Hanger 1/111 machine shop	4	P	2	4	0
West airfield drainage ditch to Blue Lake	4	L	3	5	0
Motor fuel tank	4	C	3	1	0
Engineer motor pool sump box	4	B	3	2	1
Storage shed (428)	4	10	4	1	0
Power plant (207)	4	15	4	2	0
Electric switch/generator building (427/430)	4	13	4	1	0
Alert building	4	3	4	0	0
Dispensing station	5	H	2	5	1
Automotive fuel depot (bldg 1023)	5	Q	2	5	1
Wash and grease racks (1013/1014)	5	18	3	4	0
Motor vehicle repair shops (1025/1027)	5	14	3	4	0
2600 area buildings	6	M	2	6	0
Old fire station (bldg 1800) ditch	6	D	3	3	0
Hospital area (cradle tanks)	6	G	3	13	0
Building 2609 - secondary auto fuel shop	6	R	3	4	1
Fuel dispensing station - (11th and B)	7	S	1	7	1
Fire drill pit	7	F	1	7	1
Paint disposal pit	7	O	2	5	0

* ID No taken from the original source of information, either the Earth Technology Report or personal interviews

NV/UT Border

wells (MWs) allocated to each site. To simplify sampling and site investigation, the Wendover AFAF sites were grouped into seven arbitrary study areas shown in Figure ~~2-1.~~ 2-2

A primary objective is to investigate as many of the Wendover AFAF sites as possible within the project budget. The Priority 1 locations will be tested first; then Priority 2. Priority 3 and 4 locations will be tested as fully as the remaining budget permits.

The Study Areas are defined as follows:

Area 1 is the Old Base Landfill area (Figure 4-1). A total of 30 Hydropunch-Cone Penetrometer (HP/CPT) borings are planned for this area. In addition, a total of 4 monitoring wells: 1 upgradient and 3 downgradient, are also planned. The area involved at this site is a large, roughly circular area with a radius of approximately 1,000 feet. Also, the probability that toxic substances have been deposited in the landfill is high; hence, the large number of investigative borings.

Area 2 is the V-1 Launch Site (Figure 4-2). A total of 11 HP/CPT borings are planned for this site. Because the likelihood of gross contamination is low in this area, no monitoring wells are planned.

Area 3 includes the Post Engineer Salvage Yard (Figure 4-3), at the eastern end of the cantonment area. A total of 15 HP/CPT borings and 1 monitoring well are planned for this area. The potential for contamination at this site is unknown, but thought to be fairly low.

Area 4 is at the western end of the cantonment area (Figure 4-4) and includes the POL Underground Storage Tank (UST) area, the motor pool sump, Hanger 1, Hanger 1 machine shop, motor fuel tank, the storage shed, the switch/generator, the sewage treatment

RADIAN
CORPORATION

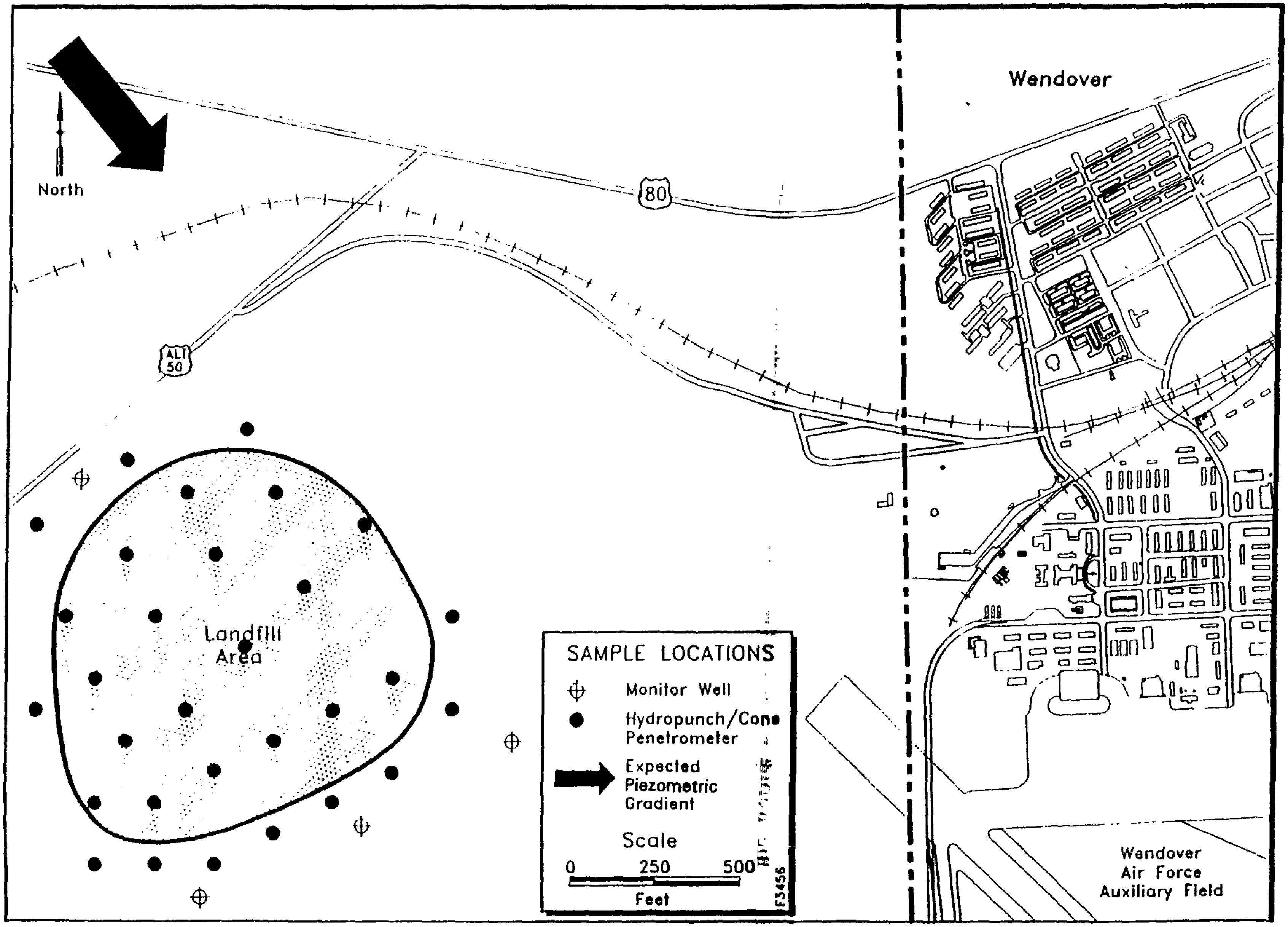


Figure 4-1. Area 1 and Proposed Sampling Locations, Wendover AFAF, Utah

RADIAN
CORPORATION

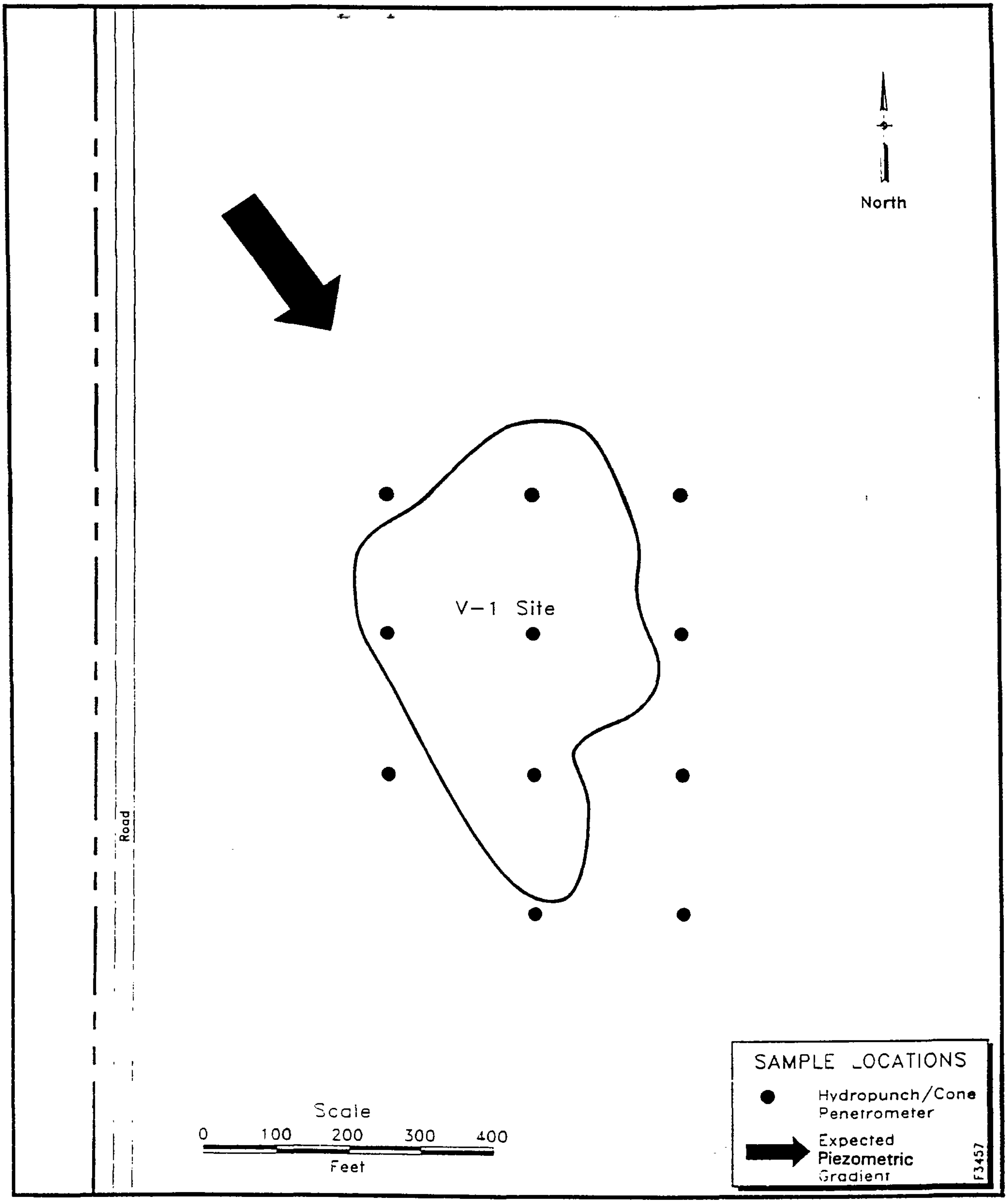


Figure 4-2 Area 2 and Proposed Sampling Locations, Wendover AFAF, Utah

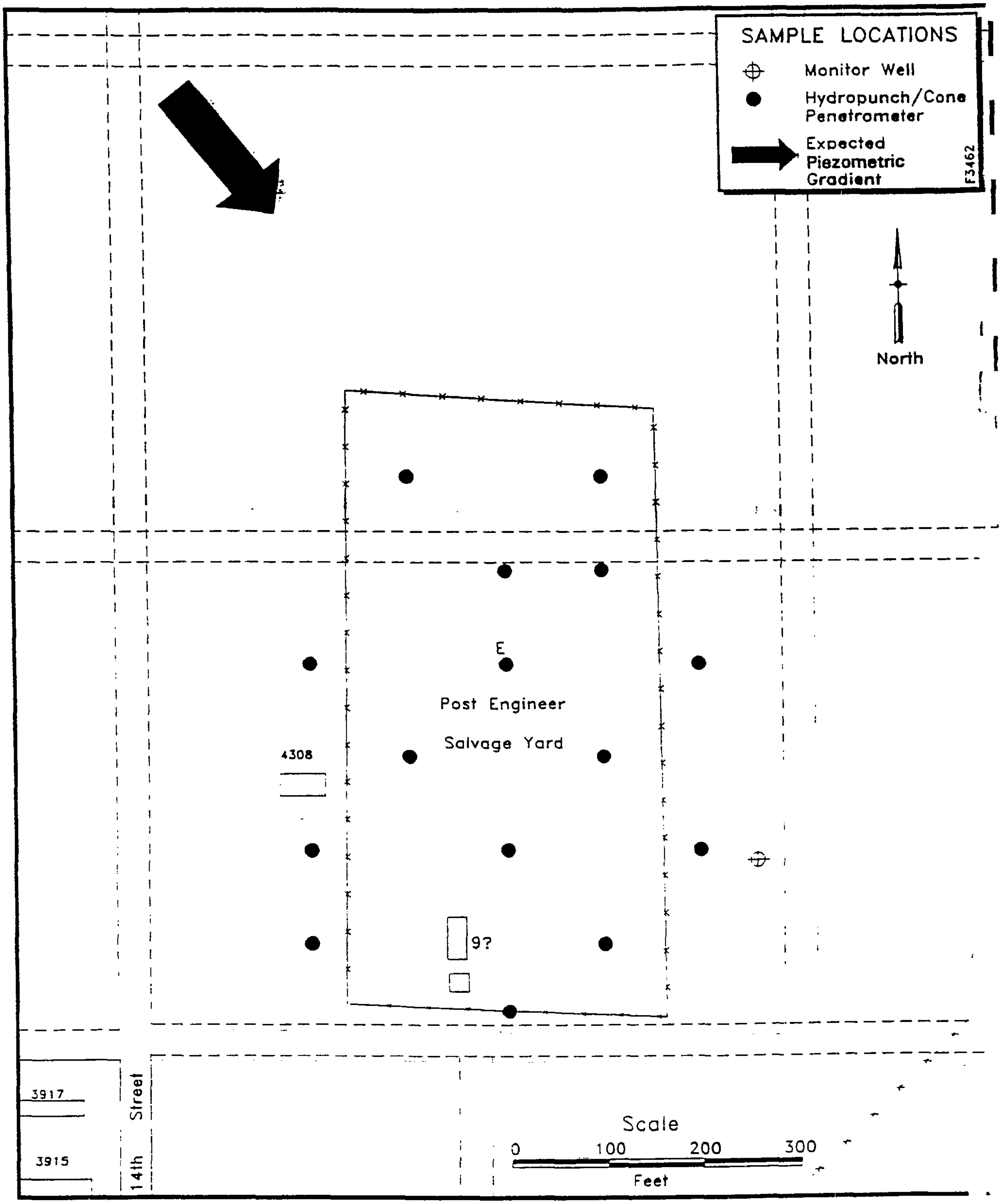


Figure 4-3 Area 3 and Proposed Sampling Locations, Wendover AFAF, Utah

RADIAN CORPORATION

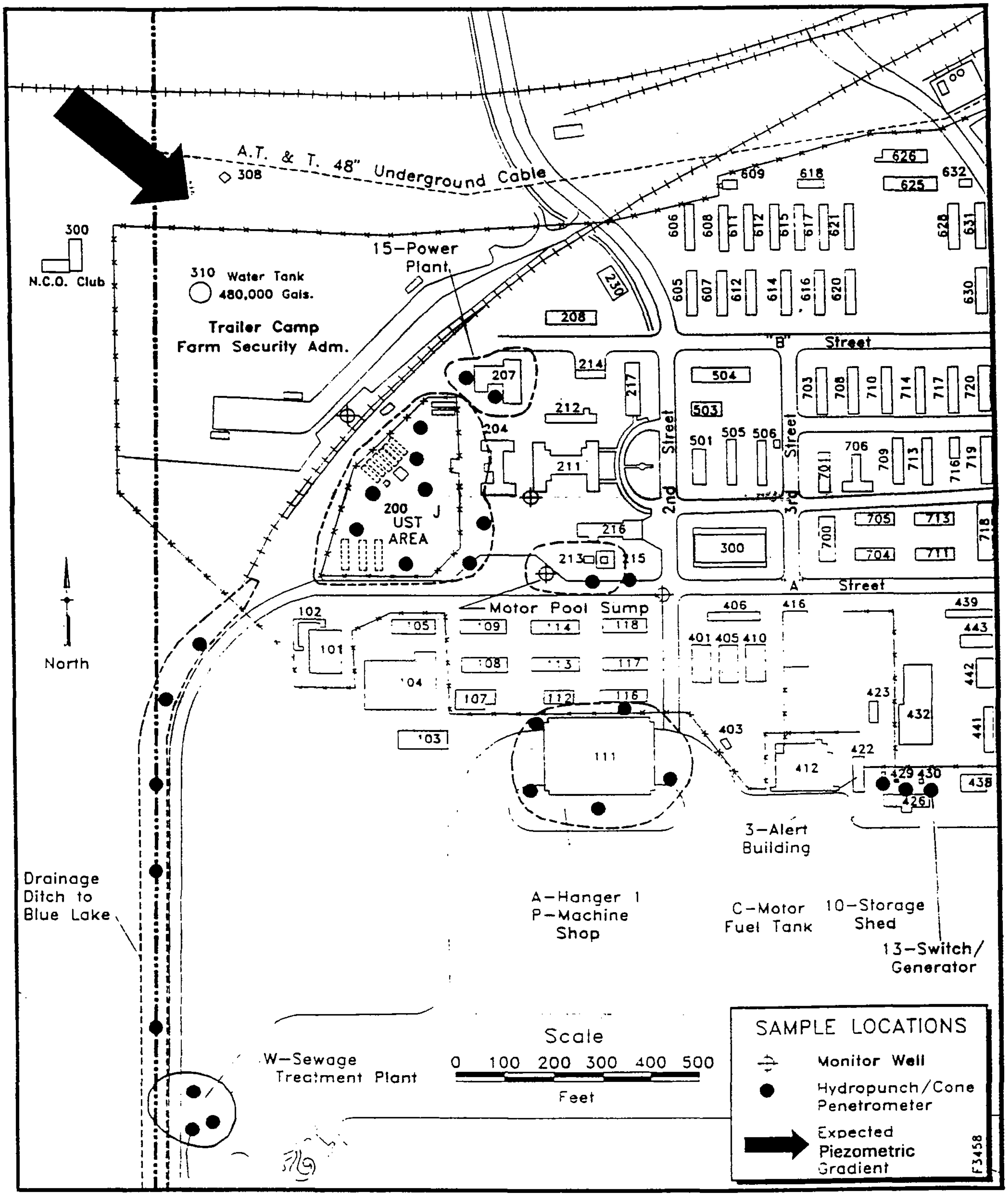


Figure 4-4 Area 4 and Proposed Sampling Locations, Wendover AFAF, Utah

plant, the power plant, and the drainage ditch to Blue Lake. A total of 27 HP/CPT borings and 4 monitoring wells are planned. Because of the diversity of sites in this area, it is felt that the likelihood of discovering contamination is relatively high, particularly at the UST and motor pool sites.

Area 5 includes the gas distributing station, the wash and grease racks, motor vehicle repair shops, and automotive fuel depot (Figure 4-5). A total of 18 HP/CPT borings and 2 monitoring wells are planned for this area. There is a good possibility that hydrocarbon contamination exists in this area.

Area 6 includes the Hospital area (Figure 4-6). It also includes a storage area for solvents, herbicides, and other toxic materials, the secondary auto fuel shop area, and the old fire station motor pool ditch. A total of 26 HP/CPT borings and 1 monitoring well are planned for this area. It is felt that reasonable chance of contamination exists in the solvent storage area and secondary auto fuel shop, so 1 monitoring well will be installed at those sites.

Area 7 includes the paint disposal pit, the fuel dispensing station at 11th and B Street, and the fire training pit located south of the 13th and B Street intersection (Figure 4-7). A total of 19 HP/CPT borings and 2 monitoring wells are planned for this area. It is felt that the possibility for contamination in this area is high at all sites in this area.

The tentative locations for HP/CPT borings and monitoring wells are shown on Figures 4-1 through 4-7. These locations should be considered for guidance only. Decisions will be made about boring and monitor well locations after evaluating the results of cone penetrometer testing. If contamination is identified by HP/CPT sampling, borings will be optimally sited to define the limits and extent of the contamination, within the scope of this project.

RADIAN CORPORATION

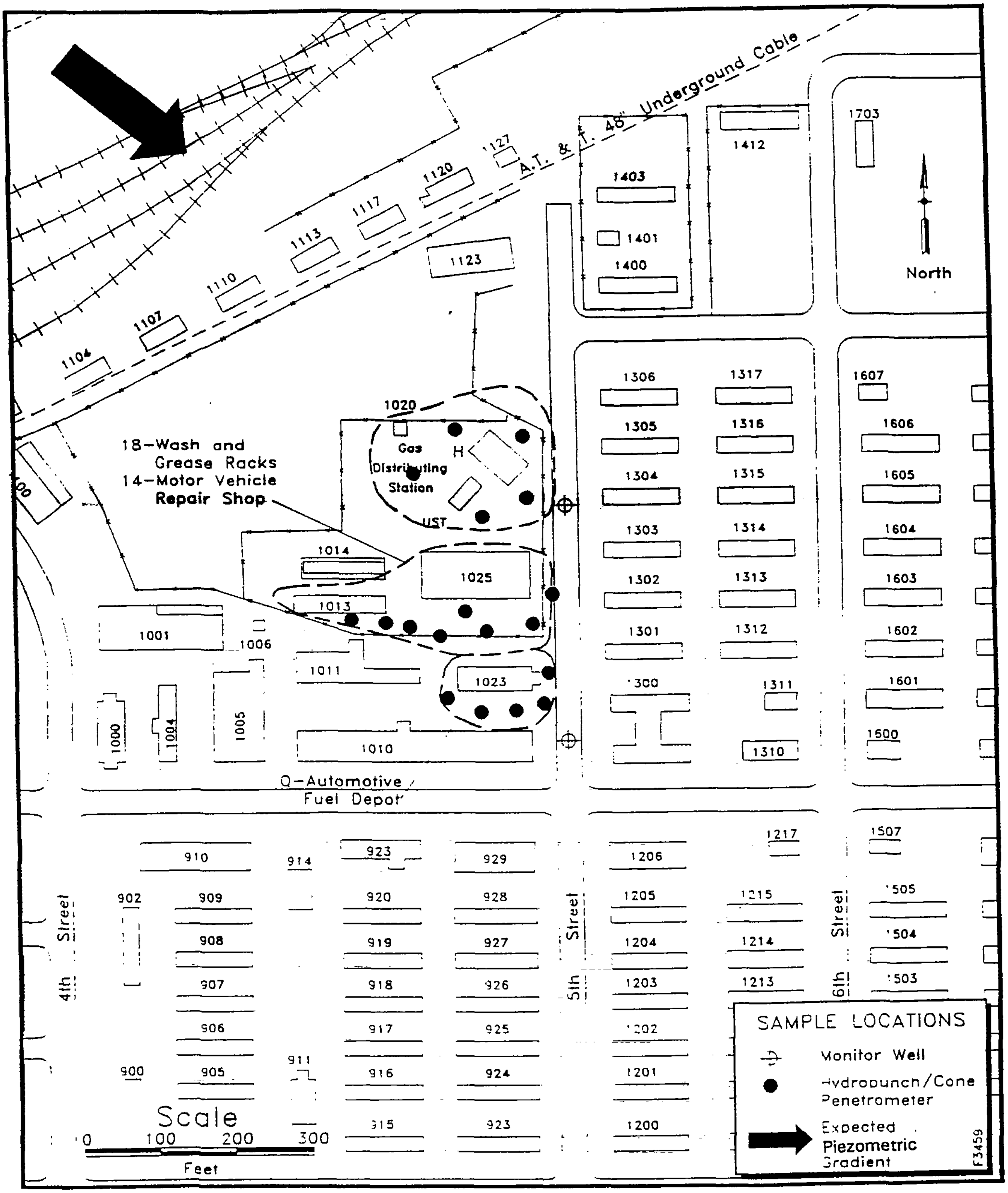


Figure 4-5 Area 5 and Proposed Sampling Locations, Wendover AFAF, Utah

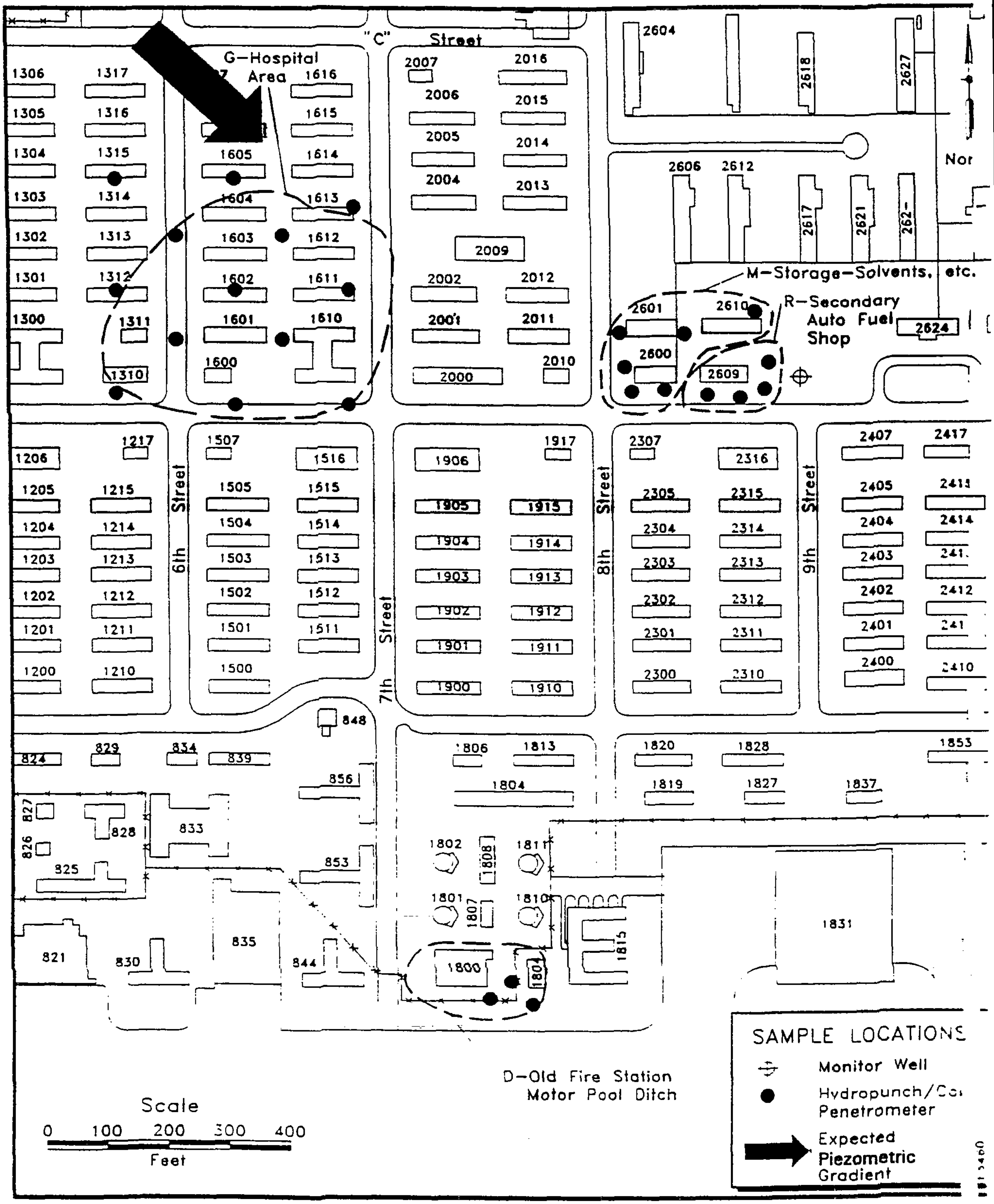


Figure 4-6 Area 6 and Proposed Sampling Locations, Wendover AFAF, Utah

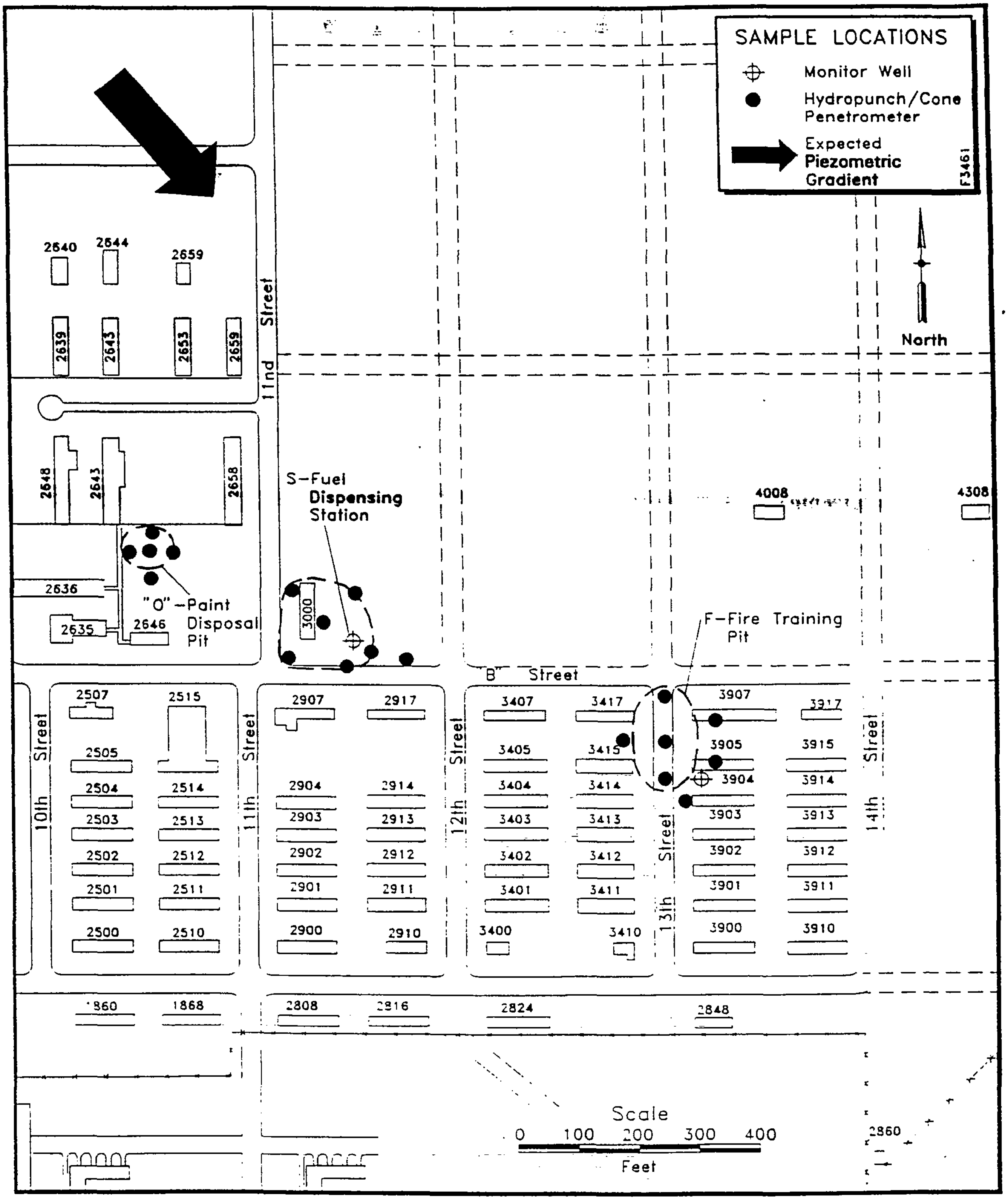


Figure 4-7 Area 7 and Proposed Sampling Locations, Wendover AFAF, Utah

4.1.2 Field Sampling

Soil and water sample numbers are proposed according to guidance according to the statement of work. A total of 55 soil samples will be taken and analyzed for the RCRA Target Compound List/Target Analyte List (TCL/TAL) analysis. Approximately forty of the samples will be investigatory samples and 15 will be QA/QC samples. A total of 18 groundwater samples will be taken. Fourteen samples, or one from each monitoring well, will be investigatory samples and the remaining 4 samples will be QA/QC samples. All samples will be analyzed for the complete TCL/TAL list, in accordance with the procedures described in Section 5.0 of this work plan.

The soil samples selected for laboratory analysis will be chosen in the field by screening samples on-site. The samples will be screened on site by headspace reading. A sample of the soil (3 to 5 tablespoons) will be put in a clean zip lock bag and shaken gently. A Photoionization Detector probe (PID) will then be inserted into the bag and a measurement will be taken when the reading reaches a maximum, or stabilizes at a value (usually 10 to 15 seconds).

Groundwater samples taken by HP/CPT methods will be analyzed on a field gas chromatograph (GC) by a qualified operator. Both field screening techniques may be biased in favor of samples which contain high proportions of volatiles. Therefore, at least one soil sample and one water sample, which do not pass the screening criteria but which are taken from an area which is thought to have a high probability of non-volatile contamination (such as heavy metals), will be taken and submitted for TCL/TAL list analyses. Some water samples will be rerun as sample duplicates and also to confirm levels of contamination where low levels of contamination are detected.

4.2 Site Evaluation Tasks

The overall objectives of this study are to gather information to develop an understanding of the groundwater system, contaminant sources, migration pathways, potential receptors and to evaluate potential impacts on the site, public health and the environment. Sites which merit further investigation will be identified. This study at Wendover AFAF will consist of field-related and data evaluation-related tasks. The following sections discuss each of these tasks in detail.

4.2.1 Field-Related Tasks

A combination of field-related tasks will be performed as shown on Table 4-3 to achieve the objectives of this program. The major field tasks involve HydroPunch testing, monitoring well installation, and soil and groundwater sampling. HydroPunch testing will involve cone penetrometer, electrical conductivity, and piezometric testing; as well as collection of soil gas and groundwater samples for field analysis using a portable gas chromatograph (GC). Up to 2,500 linear feet of HydroPunch testing will be accomplished. Up to 1,000 linear feet will be completed using piezometric cone penetration testing, with the additional 1,500 linear feet being completed utilizing piezometric cone penetration testing with electrical conductivity. Evaluation of the HydroPunch data will help in determining monitoring well locations.

Installation of a total of 14 monitoring wells will be performed during the site investigation activities. Monitoring wells will be installed through the use of hollow-stem auger drilling methods. Up to 600 linear feet of borehole will be drilled, logged, and sampled. At selected borehole locations, up to 460 linear feet will be completed with 2-inch monitoring well material.

Table 4-3

Field Tasks, PA/SI for Wendover/UTTR, Utah

Field Tasks
1. HydroPunch®   - Piezometric CPT Testing   - Electrical Conductivity   - Soil Gas Sampling/Analysis   - Groundwater Sampling/Analysis   2. Monitoring Well Borehole Drilling   3. Soil Sampling   - Analytical   - Geotechnical   4. Monitoring Well Installation   5. Well Development   6. Groundwater Sampling   7. Surveying

HydroPunch

HydroPunch® is a registered trademark of a penetrometer subsurface exploration system. The penetrometer testing method uses high capacity hydraulic rams to directly push small diameter probes deep into the ground at a constant rate, without drilling a borehole. Miniature electronic sensors, mounted inside a specialized, instrumented probe, called a penetrometer, provide a continuous record of geotechnical, hydrogeological, and geochemical subsurface conditions. Groundwater and vadose zone gas samplers are also deployed using penetrometer methods.

A specially designed truck is used to house, transport and deploy the HydroPunch® penetrometer subsurface exploration system. Twenty tons of ballast, mounted on the truck, is used to counteract the thrust of the hydraulic rams. The penetrometer truck work area is enclosed and includes all data acquisition equipment and computers, electrical power, lighting, compressed air, as well as heating and air conditioning.

Depending on subsurface stratigraphy, penetrometer sounding depths in excess of 100 feet are readily achieved. Penetrometer subsurface exploration is rapid and highly accurate. Penetrometer data are acquired without sample disturbance, generation of soil cuttings and drilling fluids, the need for extensive geotechnical laboratory testing, or lengthy laboratory turn-around time. Personnel contact with possibly contaminated soils is minimized during penetrometer operations. The small hole left after penetrometer testing is readily grouted to control cross-contamination between aquifers.

Cone penetrometer testing (CPT) and soil gas and groundwater sampling will be performed utilizing a HydroPunch® (or equivalent) system to provide initial data on subsurface geology and preliminary detection of potential contaminants. The objectives of the HydroPunch® investigation will be to collect data on site lithologies and stratigraphy, determine the presence of possible subsurface contamination, and provide information to optimally locate future groundwater monitoring wells. Depending on time and budget constraints, additional HydroPunch® probes may be used to define the extent of contamination, if detected, at individual sites within the area of investigation.

HydroPunch/Cone Pentrometer Methodology--Electric cone penetrometer testing (CPT) using the Hydropunch® methodology involves driving a steel probe by hydraulic pressure to a desired sampling depth and provides a rapid and cost-effective means of measuring parameters such as bearing resistance, friction, and pore pressure. Site disturbance is minimized since no borehole cuttings or drilling fluids are generated during penetrometer operations. Personnel exposure to possibly contaminated soil during penetrometer operations is significantly less than exposures during drilling and sampling operations.

CPT probes have built-in sensors (usually strain gauges) at the tip and sides of the probe that measure penetration resistance and side friction of soils. Tip penetration resistance and sleeve friction are typically different for clayey soils when compared to granular soils. This makes CPT useful for identifying sands and gravels, versus clays and silts. CPT can provide data to identify soils and evaluate subsurface soil profiles, correlate subsurface conditions between testing locations, evaluate soil parameters, and measure soil moisture content.

A piezometric pressure transducer is added to the basic CPT penetrometer to acquire data on pore-water pressures. Using this device, a Piezometric Cone Penetration Test can be conducted to acquire both geotechnical and hydrogeologic data. The soil electrical conductivity is measured using a two electrode system. The electrodes are mounted immediately ahead of the penetrometer friction sleeve. The electrodes are insulated from the steel body of the penetrometer by plastic insulators. As an alternating current is applied to the electrodes, the soil electrical conductivity is computed based on the comparison of voltages induced across the electrodes and a reference resistor.

A special rig is used to hydraulically push the CPT tool into the subsurface. The rigs are a specially built, anchored drill rig or trailer-mounted rig. There are light, medium, and heavy rigs depending on the thrust required to reach the desired sampling depth. The CPT rigs are often mounted in heavy duty trucks that are ballasted to a total dead weight of approximately 15 metric tons. Screw anchors are then utilized to develop the extra reaction to reach the maximum thrust of approximately 20 metric tons, if needed. The rig interiors are usually set-up to provide separate workspaces for CPT hydraulic pushing and data acquisition.

Segments of rod are added as the probe is advanced at a constant rate (typically between 0.6 to 1.0 inches per second). The CPT probe is typically composed of a 1.4 to 1.8 inch diameter probe with a conical point. Electric cone penetrometers typically have strain gauges that measure penetration resistance and side friction of soils.

Continuous measurements made by the probe and sensors are recorded and transferred through an electrical cable connected to the CPT probe to a computerized data acquisition and display computer system in the rig. Data are typically recorded at approximately every 0.4 to 0.8 inches of penetration. The CPT, piezometric pressure, and electrical conductivity data are graphically presented (sounding logs) as each individual test progresses and provides direct information on subsurface conditions. Data typically recorded on the sounding logs that utilize the piezometric pressure transducer and the electrical conductivity sensor include friction ratio, cone resistance, generated pore pressure, electrical conductivity, interpreted soil type and interpreted pore fluid. After the data is collected, interpretation can be made on-site to provide real-time information on the subsurface soils and groundwater.

CPT may not be successful in soil that contains cobbles, boulders, rock, or other debris. These materials may damage the cone penetrometer probe or make it impossible for it to penetrate into the ground. Sites included in this investigation will be evaluated for these conditions before testing begins. At the Wendover/AFAF sites, special care will be taken because of the potential for underground debris. Readings will be monitored closely as the cone penetrometer is pushed into the ground in order to recognize debris. If debris is encountered, the cone penetrometer will be pulled out of the ground, and the hole grouted. The CPT system will then be offset and a new, nearby location will be tested.

Both soil gas and groundwater samples will be collected using the HydroPunch® or other equivalent push-in temporary piezometer or sampling method. These samples will then be analyzed on-site for volatile organic compounds (VOCs). After determining the subsurface stratigraphy using the CPT method, the rig will be moved a maximum of five feet off the CPT location and an appropriate sampling probe will be hydraulically pushed into the subsurface using the HydroPunch (or equivalent) system. The sampling probe will be pushed to the desired depth above the water-table for the collection of a soil gas sample.

After collection of the soil gas sample, the sample probe will be advanced further to the desired depth below the water table to allow the collection of a groundwater sample. The rods are then retracted slightly to expose the screen. After groundwater flows into the sample chamber (this can vary from one to eight hours depending on subsurface lithologies) the sample is removed either by a small bailer, or a vacuum tube is used to collect the sample. Care will be taken to minimize disturbance of the groundwater during sample collection activities. Sample handling techniques using this method are similar to handling standard groundwater samples as outlined in Section 4.2.2.

HydroPunch CPT Testing--Before CPT testing, sites will be located, numbered, and identified using stakes (or paint on paved surfaces), and cleared by the appropriate utilities personnel. Each testing location will have two individual sites that will be separated by a distance of no more than 5 feet. The first site at each location will be for CPT testing and the second site will be for soil gas and groundwater sampling. After the test sites have been located and cleared for utilities, the rig will be set-up for CPT testing. The procedure for conducting CPT testing at a specific location is as follows:

1. Decontaminate the rig and downhole equipment by steam cleaning.

2. Setup the rig to obtain a thrust direction as close to vertical as possible. The maximum acceptable deviation from vertical is 2%.

3. Advance the CPT probe and add CPT rods connected hand-tight as the probe advances. The electrical cable used to transfer data to the surface will be continuous, and it will be prethreaded through the push rods before the test begins.

4. Check the computer data acquisition system before CPT begins and also during testing to ensure that it is working properly.

5. Advance the CPT probe at a continuous rate of 0.6 to 1.0 inches per second to the desired depth.

6. Record the appropriate readings/measurements at every 0.4 to 0.8 inches of penetration using the computer data acquisition system.

7. Review and evaluate field plot(s) generated by the data acquisition system to ensure data quality.

8. When the test is complete, pull the CPT probe and rods out of the subsurface and grout the hole from the bottom as the rods are withdrawn.

CPT Calibration and Checks--The CPT probe will be checked before a test begins and between test holes to ensure that its dimensions and surface roughness are within acceptable limits. The test system will also be calibrated as needed, and the calibration will be documented. Specifically, the load cells will be calibrated according to manufacturer specifications and industry standards at least every three months.

Before performing CPT, the straightness of the push rods will be checked. The bottom five push rods will be particularly checked by rotating them to see if they wobble. If a wobble is noticeable, the push rods(s) will not be used.

HydroPunch Sampling--Following the completion of CPT testing at each location, soil gas and groundwater sampling will be performed. The procedures for soil gas and groundwater sampling are as follows:

1. For each study area at least one CPT probe will be driven to establish the site soil characteristics and depth to groundwater. Subsequent locations at each site (Figures 4-1 through 4-7) will be sampled using Hydropunch techniques at depths indicated by the CPT.

2. Decontaminate all downhole sampling equipment by steam cleaning.

3. Advance the appropriate sampling probe and rods hydraulically in the same manner as was accomplished for the CPT testing. Deploy the sampler to the desired sampling depth above the water-table and obtain a sample of soil gas from the vadose zone. Actual sampling procedures will vary depending on the specific equipment utilized by the HydroPunch (or equivalent) subcontractor. Once the soil gas sample is retrieved, it will be analyzed for VOC's using an on-site portable gas chromatograph (GC).

4. After collection of the soil gas sample, the sampling probe will then be pushed further until the desired depth below the water-table is reached. Once the sampling depth is reached, the sampling device will be opened to allow groundwater to flow inside. The groundwater sample will then be retrieved to the surface for on-site VOC analysis using the field GC unit. When feasible, field parameters (temperature, pH, and specific conductivity) of the groundwater samples will be measured. Measurement of field parameters will be dependant upon obtaining sufficient sample volume.

Location Marking--At the completion of each HP/CPT boring, the location will be marked by driving a marking stake at least 18 inches into the ground. The stake will protrude at least 24 inches above the ground surface and will be painted or otherwise permanently marked with the location identification number.

On-Site Gas Chromatograph--An on-site gas chromatograph will be used to provide analytical results in the field immediately after sample collection. Both soil gas and groundwater samples will be analyzed for VOC's by a qualified operator. Calibration procedures will be performed in accordance with the equipment manufacturer;s recommendations. For quality control (QC), about 10% of the samples will be run as duplicates.

Monitoring Well Drilling

The primary objective of the PA/SI at Wendover/UTTR is to determine if past activities at the sites being investigated had a negative impact on the environment. To assist in accomplishing this task, 14 monitoring wells will be installed. The locations of these wells will be determined in the field based on the results of the HydroPunch testing. Well construction shall be in accordance with appropriate State of Utah Administrative Rules for Water Well Drillers (July 1985) for the purpose of examining the groundwater, for the presence of contamination, and defining the local hydrogeology.

Because of uncertainty regarding the local hydrogeology, and the expected levels of contamination, decisions to modify the proposed number and location of test wells will probably be made during the field investigation. The Hill AFB Project Manager will be informed of all proposed well locations prior to drilling.

The depth of boreholes for the investigation shall be determined by a Radian hydrogeologist in consultation with the Air Force Project Manager. Field drilling operations and logistics shall be coordinated with Civil Engineering facility personnel to avoid interference with existing utilities and traffic patterns.

The drilling operations will be conducted by a subcontractor under the direct supervision of the Radian geologist or hydrogeologist. Hollow-stem auger drilling methods will be used for the monitoring well borehole drilling.

Drilling Preparation--Prior to beginning drilling activities at any location, all necessary permits and clearances will be obtained. Only then will drilling equipment be mobilized to the field. Radian Corporation will be responsible for obtaining a base digging permit for each location prior to conducting any subsurface work. Digging permits will be requested a minimum of three weeks prior to any drilling activities. An appointment will be made with the Red Stakes office by calling (801)777-1995.

The rig shall be positioned such that the center of the borehole is within 0.5 feet of the predetermined well or boring location identified by a stake or paint mark. Such accuracy is necessary to avoid underground utilities, possible violation of property lines, rights-of-entry, or other agreements that have been negotiated with Hill AFB personnel.

Prior to drilling a borehole, the drill string (casing, auger, drill pipe, bit, etc.) and rear portions of the drill rig shall be cleaned by a high pressure, hot water wash (>180°F and >200 psi) in a designated decontamination area. Upon completion of decontamination and mobilization of drilling equipment to the drill location, exclusion and support zones as referenced in the Health and Safety Plan shall be identified and marked prior to commencement of drilling operations. All health and safety equipment (tables, water, eye wash station, etc.) will also be set up at this time and shall be located in an upwind direction. The site geologist/technician shall be responsible for this effort. Also, the technician will be on-site to monitor borehole and cuttings vapors with an organic vapor meter during drilling.

Hollow-Stem Augering--The field team will use a hollow-stem auger rig to drill and continuously sample the monitor well borings. This method performs well in unconsolidated sediments, allows the rig to operate without the use of drilling fluids, and permits ease of collection for relatively undisturbed formation samples. The hollow-stem auger can be used as a temporary casing to prevent the borehole from caving during drilling and well completion. For the expected depths and type of geology, this drilling method will provide fast, efficient performance at a relatively low operating cost. Soil samples will be collected using a split-spoon sampler or similar device through the hollow-stem augers.

During drilling operations, a Radian geologist will collect and describe formation samples. Lithologies will be classified according to ASTM D-2487, the Unified Soil Classification System. The soil samples will be described in terms of lithology, moisture content and any evidence of contamination. Screening for evidence of contamination will be accomplished using a Photoionization Detector (PID) with an energy source of 11.7 KV to enable detection of chlorinated compounds in the field. Visual and odor characteristics of the samples will be noted. If high levels of organic compounds are detected, Draeger® tube screening will be employed for use as an additional screening method.

Split-Spoon Sampling--Soils from each borehole will be sampled above and below the water table using an eighteen-inch long split-spoon sampler. Soil samples will be collected by inserting the split-spoon sampler through the augers. The samples from the split-spoon sampler will be retrieved in brass sleeves which will be inserted into the split-spoon sampler prior to sampling. Further detail regarding soil sampling is presented in Section 4.2.2.

Well Installation and Construction--All well casing and screen will be inspected for defects before being placed in the borehole; only defect-free materials will be used in the monitoring well construction. The wells will be screened using 316 stainless steel screen with an appropriate slot size as dictated by local geology. The screen will have a stainless steel bottom cap that is flush with the bottom of the screened interval (no sediment sumps). 316 stainless steel riser will be used above the screen and will extend to a minimum of two feet above the existing water table. Schedule 40, flush threaded, PVC casing will be installed above the stainless steel interval. No glues or thread compounds will be employed during well installation or completion that may affect chemical analytical results. The casing and screen will be installed within the hollow-stem augers.

Once the casing and screen are in place, a suitable grade washed and sorted silica sand pack will be installed through the auger while the auger is backed out of the hole. The sand will be installed from the bottom of the test hole to a maximum of 2 feet above the top of the screened interval. To ensure proper packing of the sand pack material, surging of the well will be performed with a properly sized, decontaminated surge block. A 3-foot (minimum) bentonite seal will then be emplaced above the sand pack by pouring bentonite pellets through the auger. Once sufficient time has passed for the bentonite to hydrate (potable water may be added to the bentonite to aid hydration) and form a complete seal, the remainder of the hole will be grouted to the land surface with a Type I Portland cement slurry containing 3-4% bentonite.

Well-head construction will consist of a 3-foot by 3-foot by 0.5 foot cement pad with a surface sloped away from the well head. Additionally, three 3-inch diameter steel guard posts and a locking steel cover will be installed to protect the well. A flush-mount well head may be installed as an alternative in the cantonment area if indicated by the local situation.

Well Development--Each well will be developed no sooner than 48 hours after completion with a small diameter inertial pump. Well development will continue until the discharge water is clear and free of sediment to the fullest extent possible and a minimum of five well volumes of water have been removed. Turbidity measurements will be taken and efforts will be toward attaining a stable value. Parameters such as pH, specific conductance, temperature, and discharge rate of the water produced during well development will be measured and recorded every 15 minutes to establish when development parameters stabilize.

All monitoring well development and subsequent purge water will be containerized in 55 gallon drums and handled as presented below in the Waste Handling discussion of this Section.

Surveying--All Hydropunch and monitor well locations will be surveyed to allow for accurate map sample locations and to provide reference for water level measurements. At the completion of drilling operations, a licensed land surveyor will determine the vertical and horizontal position of the reference point. The elevation of the top of PVC casing at each wellhead will be determined to an accuracy of ± 0.01 foot. The surveyor will identify the benchmark on the steel well casing. The horizontal location of the monitoring wells will be determined to an accuracy of ± 0.1 foot.

Equipment Decontamination

HydroPunch--All equipment including the rig, probe, rods, etc. will be decontaminated before arrival at the work site. Between test holes, all downhole equipment will be decontaminated at a designated decontamination area. Steam cleaning will be the method of decontamination for all equipment associated with the HydroPunch (or equivalent) system.

Decontaminated equipment will be placed on new plastic or racks until it is used. The rig will be decontaminated when moved out of a work area or when it becomes unusually dirty as a result of site or testing conditions, at the discretion of the supervising geologist.

Drilling and Soil Sampling--After drilling each borehole, all augers, drilling rods, and sampling devices used will be transported to a central decontamination area. A high-pressure steam cleaner will be used to clean the equipment.

During soil sampling, the split-spoon sampler will also be decontaminated by: 1) washing in a non-phosphorous detergent, such as Liqui-Nox, and potable water solution using a brush; 1) rinsing with potable water; 3) rinsing with deionized reagent water; and 4) rinsing with methanol. Clean brass liners will then be placed into the sampler in preparation for collecting the next sample. After completion of each soil boring, the sampler will be decontaminated by steam-cleaning.

The brass sleeves will have been prepared for use by the following four-step process:

- Washing in a solution of detergent and potable water;
- Rinsing with potable water;
- Rinsing with deionized water; and
- Baking at 106°C for a minimum of eight hours.

Groundwater Sampling--All down-hole equipment used during the purging and sampling of the monitoring wells will be carefully washed to prevent cross-contamination with a solution of laboratory grade soap (Alconox) and potable water, rinsed with drinking-quality water, ASTM Type II water, pesticide-grade methanol, and a final rinse of pesticide-grade hexane. Following the hexane rinse, equipment will be air dried. As an additional step to prevent cross-contamination of the wells, purging/sampling operations will progress from areas suspected to contain little or no contamination to areas assumed to have higher contamination levels.

Waste Handling

Waste Soil--During the monitoring well borehole drilling activities, all cuttings will be containerized in 55 gallon drums. Drums will be labeled with EMR labels and transported to the drum storage area at Operable Unit 1 (OU-1). This activity will be coordinated with Mr. Sam Johnson/EMR at (801)777-8790. The results of the sample analysis and headspace readings will be used to determine the final disposition of the cuttings in the drums. A copy of the chemical analysis will be submitted with each drum.

If the cuttings are nonhazardous, Radian will dump the drum contents at the soil disposal yard. This activity will also be coordinated with Mr. Sam Johnson. If the cuttings are classified as hazardous, the drums containing the cuttings will be transported from the storage area to the Hazardous Waste Control Facility (Building 514). This activity will be coordinated with Mr. Steve Dodge at (801)777-1087. A copy of the chemical analysis will be submitted with each drum. The material will then be disposed of by the Air Force through the base hazardous waste program).

Drums will be removed from the drum storage area within 60 calendar days after drilling occurs. Drums that are not classified as hazardous waste shall be taken to the base disposal yard and dumped. Those that are classified as a hazardous waste will be transported from the storage area to the Hazardous Waste Control Facility (Building 514). This activity will be coordinated with Mr. Steve Dodge at (801)777-1087). A copy of the chemical analysis shall be submitted with each drum. The material will then be disposed of by the Air Force through the base hazardous waste program.

Waste Water--All monitoring well development and subsequent purge water will be containerized in 55-gallon drums. Drums will be labeled with EMR labels and transported to the drum storage area at OU-1. This activity will be coordinated with Mr. Sam Johnson/EMR at (801)777-8790. A determination will be made as to whether or not the purge waters are to be classified as hazardous waste based on analytical results.

4.2.2 Environmental Sampling Procedures

Soils

Screening will occur during borehole drilling activities using an 18-inch split-spoon sampler inserted through the hollow-stem augers to allow for the collection of soil/formation samples. The outside casing of the split-spoon sampler will be opened longitudinally to insert/remove the brass sleeves which will be used for collection of soil samples. After the sampler is removed from the hole, the sleeves are removed from the holder and those selected for analysis are covered with Teflon tape and capped with PVC caps. The capped sleeve is then labeled and placed in a Ziploc bag to prevent cross-contamination and is placed in a cooler with ice for shipping to the analytical laboratory.

For sampling of unconsolidated and uncemented sands or gravel deposits, a split-spoon sampler equipped with a sand catcher will be used to prevent sample loss from the bottom of the samples. The catcher will be decontaminated in the same manner used to decontaminate the split-spoon sampler. During the drilling, soils will be cored and logged using a five-foot coring device.

Soils will be screened in the field using a PID organic vapor detector and/or Draeger tubes in order to detect the presence of volatile organic contaminants. In addition, soil and formation samples will be collected using an 18-inch split-spoon sampler for both chemical and geotechnical analyses. A sample will be collected from both above and below the water table in each borehole at the discretion of the supervising geologist. The split-spoon samples will also be analyzed with a PID for headspace analysis. Headspace readings will be taken by placing a small amount of the sample material (about three to five tablespoons) in a Ziploc plastic bag and shaking gently. The PID instrument probe will be inserted into a small opening in the top of the bag. The recorded reading will be the maximum instrument reading observed when the needle stabilizes or maximizes (usually about five to twenty seconds).

Instrument readings of volatile organic levels will be recorded on the field log. These field instruments, although calibrated, will be useful only as indicators of the presence of significant contaminant levels. Because the instruments are sensitive to moisture and fluctuating ambient conditions, small concentrations above background listed on the field logs should be considered insignificant. The organic vapor concentrations which may be detected in disturbed soil samples represent an indication of the presence of gross organic contamination only, and in no way are intended to represent the actual levels of individual contaminants present in the formations.

Chemical Analyses--Samples of soil will be collected during drilling activities for chemical analysis. At least one sample from the unsaturated zone and one sample from the saturated zone will be collected from each of the 14 boreholes and submitted for chemical analysis. A total of 55 soil samples will be collected and analyzed for the RCRA Target Compound List/Target Analyte List (TCL/TAL). Approximately 30 percent of these samples will be QA/QC samples.

Geotechnical Testing--One core sample from each of the 14 boreholes will also be chosen for various geotechnical testing. Based on the encountered soil type, these tests may include moisture content, sieve analysis, hydraulic conductivity, organic content, and cation exchange capacity. The geotechnical samples will be collected at the discretion of the supervising geologist to adequately characterize the borehole lithologies encountered. Emphasis will be placed on characterizing the water-bearing unit(s) and confining layer(s). Geotechnical samples collected in brass sleeves as described above or will be preserved in 1-quart glass jars for shipment to the subcontracted laboratory for analysis.

All sample data will be entered on chain-of-custody forms following collection. These forms will document the acquisition, possession and analysis of each sample.

Groundwater

One round of groundwater samples will be collected from each of the 14 monitoring wells installed during this investigation. A total of 18 groundwater samples will be collected and analyzed for the RCRA Target Compound List/Target Analyte List (TCL/TAL). Four of the samples will be collected for QA/QC purposes. Groundwater sampling activities will begin in areas of suspected low contamination and proceed to areas believed to possibly contain higher levels of contamination.

Prior to collection of groundwater samples from each monitoring well, the static water level will be measured, the well will be purged to ensure collection of representative samples. Field pH, temperature, and conductivity will be measured and recorded during well purging activities. Field parameters will be allowed to stabilize prior to sampling. A detailed discussion of monitor well sampling procedures is presented below.

Groundwater Level Measurements--Following completion and development of the monitoring wells, a round of water level measurements will be conducted. At least one week will be allowed for water levels within the developed monitor wells to equilibrate. Water levels will be measured to the nearest 0.01 feet from the top of the permanently marked casing using an electric line water-level indicator. The instrument will be lowered down the well and water depths measured from the top of the blank casing. When the electrode of the water-level meter comes in contact with the water, a meter reacts or a tone sounds. Water level measurements will be conducted prior to any well purging and sampling activities. Water levels will be remeasured after sampling and after the water conditions in the wells have stabilized. The groundwater level represents a point in a three-dimensional aquifer system. Therefore, in order to properly interpret the data, the monitoring wells will be surveyed by a registered Public Land Surveyor to an accuracy of 0.01 feet vertical control and 0.1 feet horizontal control.

Well Purging--Each monitoring well will be purged immediately prior to sample collection to insure that fresh formation water is collected. Prior to purging the wells, the surface of the water table will be examined for the presence of floating contaminants and liquid from the bottom of the well will be examined for the presence of any sinking immiscible layer. If present, the thickness of any contaminant layer will be measured. A transparent bailer will be used in determining the thickness of any floating or sinking layer. Should the floating or sinking layer be greater in thickness than the bailer length, an interface probe will be used to determine the thickness of the product in the well casing.

Purging operations will be conducted using a Waterra® inertial pump system consisting of 5/8" high density polypropylene tubing and a PVC foot valve. These materials will be dedicated to a particular well to further ensure against potential cross contamination. Purging operations will be considered complete when three saturated well volumes (based on borehole diameter) have been removed. The pH, temperature, specific conductance, color, odor, and turbidity of the discharge will be monitored and recorded after each well volume is purged or every 15 minutes, whichever is the shorter interval. After purging the wells, groundwater samples will be collected using the same Waterra® system (fitted with 1/8" tubing for volatile sampling).

On-Site Sample Temperature Analyses--Measurements of the sample temperature will be taken using an accurate thermometer. The field measurement represents the temperature of the aquifer unit at a particular location and time. Variations in sample temperature may enable interpretation of a temperature gradient which reflects aquifer hydraulics.

On-Site pH Analyses--The pH of each sample will be measured with a properly calibrated Myron LpDS (Model EP10/DS) meter or equivalent. The pH of the sample will be measured immediately upon collection to prevent deterioration. Large fluctuations of pH values within the same water-bearing zone may represent contaminant effects on the groundwater chemistry.

On-Site Specific Conductivity Analyses--The specific conductivity of each sample will be measured with a Myron LpDS meter (Model EP10/pH) or equivalent. Elevated specific conductivities indicate the presence of conductive ions such as chlorides and sulfides in the groundwater. High concentrations of these ions may indicate contamination.

Sampling for Laboratory Analysis--Groundwater sampling of monitor wells will begin in areas of suspected low contamination and proceed to areas believed to possibly contain higher levels of contamination. Sampling will begin immediately after purging, when water volume is sufficient for sampling. If a well purges dry, volatile organic compound (VOC) samples will be taken as soon as there is adequate water volume. A total of 18 groundwater samples will be collected and analyzed for RCRA Target Compound List/Target Analyte List (TCL/TAL).

Water samples collected from the wells will be placed in laboratory prepared containers, acidified as appropriate, chilled to 4°C and shipped to Radian Analytical Services in Austin, Texas. Sample containers will be kept in a cool, dry location prior to use. Analytical methods, preservations, and holding times are provided in detail in Section 5.0.

Sample Containers, Preservation and Storage

Sample containers will be purchased pre-cleaned and treated according to U.S. EPA specifications for the appropriate methods. Cleaned containers will be stored separately to prevent exposure to fuels, solvents, and other chemicals used to support site activities. Amber glass bottles are routinely used where glass containers are specified in the sampling protocol. Section 5.0 of this work plan describes sample storage and preservation requirements for each method and matrix.

All samples will be labelled and field parameters and observations will be documented in the field at the time of collection. Chain-of-custody and shipment and handling procedures will be followed to ensure that samples can be tracked. Sample possession and results will be documented through the analysis and reporting process. Information about sample shipment will include: laboratory addresses, packing materials, return shipment of coolers, and arrangement for Saturday delivery. This information, as well as transfer of field data to the database, will be provided in the field task instructions prior to the beginning of the sampling event.

4.2.3 Recordkeeping

All field operations and sampling and analytical activities performed during this investigation will be appropriately documented. These activities include HydroPunch/CPT, drilling, monitoring well installation, sampling, analytical, surveying, and waste handling. A discussion regarding the specific documentation of the HydroPunch, drilling and monitor well installation, and environmental sampling activities is presented below.

HydroPunch Data Documentation--All pertinent information and data generated during the CPT test will be recorded in an appropriate format. Also, data generated by the piezometric pressure transducer and soil electrical conductivity sensor will be recorded in conjunction with the CPT testing. A Cone Penetrometer Testing Form will be filled out by the CPT testing contractor for each test hole. The Cone Penetrometer Testing Form will be supplied by the CPT contractor and will include the following minimum information and have space for comments and documentation of general observations:

- Project name;
- Date and time of activities;

- Site location and site identification number;
- Weather conditions;
- Testing company and personnel;
- Equipment descriptions (i.e., rig, probes, etc.);
- Environmental monitoring results;
- Grouting details;
- End-of-day status (i.e., partially complete, complete, etc.); and
- Comments and observations.

During the course of this HydroPunch (or equivalent) investigation; CPT, piezometric, and electrical conductivity data will be generated. These data will be graphically presented (sounding logs) during each test. The data included on each log will be dependant upon the tests conducted at each location. A log showing the full suite of tests (CPT, piezometric, and conductivity) will typically contain the following information:

- Friction ratio;
- Cone resistance;
- Generated pore pressure;
- Results of dissipation tests, if conducted;
- Electrical conductivity;
- Interpreted soil type; and
- Interpreted pore fluid.

All final sounding logs will have headers. At a minimum, the header should include the following information:

- Project name;
- Date and time;
- Site location and identification number;
- Depth reference;
- Testing company and operator;
- Equipment information; and
- Total depth.

Drilling and Monitoring Well Installation Documentation--During borehole drilling and monitoring well installation activities, the following forms shall be completed:

- Log of Drilling Operations;
- Well Completion Log;
- Daily Field Report including equipment maintenance;
- Well Development Log; and
- Photo-Ionization Detector Screening Data Sheet

In addition to completing these forms, the site geologist will be responsible for keeping a daily log of events and observations in a field notebook. Contractors may use different forms; however, equivalent information must be recorded.

The Log of Drilling Operations will include descriptions of subsurface materials encountered while drilling. Subsurface materials shall be classified and logged in accordance with the Unified Soil Classification (USC) System. The lithology shall be recorded in the field log in the following order:

1) Predominant lithologic type with major modifiers (i.e., gravelly sand, silty sand, clayey silt, silty clay);

2) Grain size;

3) Minor modifier(s) (i.e., some silt, trace clay, etc.);

4) Color (based on Munsell Soil Color Chart);

5) Relative moisture content (i.e., dry, damp, moist, wet, saturated); and

6) Other descriptive terminology as appropriate, such as, but not limited to:

   a) Relative density or consistency;
   b) Observed bedding;
   c) Visual evidence of contamination:
   d) Distinctive mineralogy (i.e., micaceous);
   e) Sorting or grading; and
   f) Presence of odor, discoloration, or free product.

In addition to continuously logging the encountered subsurface materials, pertinent information regarding drilling operations will also be recorded on the log form. Such entries may document drilling times, rig "down" time, problems with drilling methods, etc. The occurrence and quantity of groundwater encountered while drilling will also be documented.

Environmental Sampling Documentation--Samples of materials that will be sent to laboratories for physical or chemical parameter measurements will be contained in appropriate glass containers or sleeves and appropriately documented. All samples will be labelled clearly with the following information:

- Project name/client;
- Well number or sample location;
- Sample type (analytical method);
- Preservatives used;
- Sampler's name and initials; and
- Date and time of sample collection.

Labels are completed using a ballpoint pen and securely attached to the sample jar. **Permanent markers (i.e., Sharpie®) are not used in the vicinity of sample collection activities because they contain volatile organic compounds that may contaminate the sample.** To ensure future legibility and limit the potential for cross contamination in case of breakage, all sample jars will be sealed and transported in individual Ziploc® bags.

4.2.4 Field QA/QC Program

QC Samples--Duplicate (Split) Sample Procedures--When duplicate samples are required, the sample will be divided such that all the containers have a representative portion. Samples to be analyzed for volatile contaminants will be collected first and will be placed directly into the sample container with minimal disturbance. Water samples will be split by pouring an equal volume of liquid among the containers for each collection. The containers will then be labeled on-site and the sample information recorded in a log book.

Field Instrument Calibration

Conductivity meters, pH meters, thermometers, and flame ionization detection or (FID) are used during groundwater sampling. The conductivity meters and pH meters are calibrated on a daily basis prior to sample collection and also at the end of each field day. The conductivity meter is calibrated according to manufacturers instructions with two standards bracketing the expected conductivity range. The pH meter is calibrated and adjusted with two buffer solutions which bracket the expected sample pH. A single point calibration check using the pH 7 buffer is performed at each well. If the meter drift is 0.1 pH units or greater, the two point calibration is repeated. Any instrument drift at the end of the day is also noted in the calibration field log.

4.2.5 Site Management

The on-site geologist is responsible for management of all site activities including clearance of the sampling site, setup of sampling rigs and appropriate exclusion zones, logging of all sampling activities, site clean-up, and permanent marking of all monitor wells.

4.3 Evaluation-Related Tasks

The objectives of the data evaluation process are to summarize the information on the contaminant sources, migration pathways, potential receptors, and to evaluate potential impacts on the site, public health, and the environment. Site-specific analytical data resulting from the field investigation at the Base as well as regional information are considered in the evaluation process.

Data Management

The data collected during this investigation will be managed using a computer spreadsheet program such as Lotus 1-2-3. This data management approach is being used because of the relatively small amount of analytical data that will be generated from this project. Field data will be managed in a manner consistent with future input into the IRPIMS database.

Hydrogeologic Assessment

The purpose of the hydrogeologic assessment is to identify contaminants in the groundwater system in the areas of interest. An additional goal is to develop an assessment of the completeness of the data or identify data gaps to be satisfied by subsequent sampling in an RI/FS or other study, if needed. This evaluation includes: developing an understanding of the site hydrogeology and groundwater flow by determining the relationship between areas elevated soil gas concentrations and water-borne contaminants. The results of this investigation will allow an assessment of whether the possible contaminant source areas are contributing to groundwater contamination.

Also, the study will be augmented with any regional and area studies performed by federal, state, and local agencies. Other published and unpublished information will be used, if available.

Evaluation of Data

The basis for assessing a site for its impact on the environment is based in large part, if not entirely, on the value of the data collected about the site. These data are normally in the form of field observations as well as physical and chemical data collected during the project. This information forms the foundation for making the interpretations about the site and its potential for adverse health determinations.

A field evaluation of the day's data will be done at the end of each work day. This information will be used by the Project Director and the Project Field manager to select locations for the next day's activities.

The data will be screened for quality control purposes as it is received. The content will be screened for appropriateness and completeness. The data will be evaluated in accordance with the statement of work and the detailed specifications of this work plan and the quality assurance procedure plan.

Map Preparation

To support the reporting effort, maps will be prepared utilizing an in-house computer system that will permit relatively fast development and editing of the maps. The system permits the integrating and development of geologic cross-sections combined with the plane maps. The system also permits various scales to be quickly tested and used to provide the map size desired for the report. The result will be map figures and legends that are clear and of publishable quality.

Hazard Ranking System (HRS) Scoring

The Hazard Ranking System (HRS) will be used to evaluate the relative potential of uncontrolled hazardous substance facilities to cause health or safety problems, or ecological or environmental damage. The HRS is a means for applying uniform technical judgement regarding the potential hazards presented by a facility relative to other facilities. The HRS scoring of the Wendover/AFAF sites is intended for USAF internal use.

The HRS work sheets outline parameters to be evaluated and the assignment of a score. Parameters include whether or not there is an observed release, contaminant route characteristics, containment, waste characteristics, and potential human receptors (targets). Once individual scores for all parameters are entered, the total score for the site can be calculated for comparison to other sites.

4.4 Project Organization

Radian's project team for the Wendover/UTTR study will be composed of a Program Manager, a Project Director, a Project Field Manager, and one or more Task Leaders. The project organization is shown in Figure 4-8. Roles and responsibilities of key personnel are discussed below.

4.4.1 Roles and Responsibilities

Mr. William Boettner will serve as the Program Manager for this project. In this role, Mr. Boettner will have the overall responsibility, authority, and accountability for the project. He will function as the primary interface between Hill AFB/EMR, Radian management, and the project team. In executing these duties, he will:

- Have responsibility for meeting all contractual requirements for the project;
- Administer and supervise all contractual requirements for the project;
- Direct formulation of work plans in accordance with client directions;
- Have responsibility for assuring that required staffing levels and technical expertise are provided;
- Keep Hill AFB/EMR informed on all aspects of the program including expenditures, progress, problems, and recommended solutions;
- Be available to the Radian Project Director and Field Manager for action on any problem requiring additional management or technical support;
- Keep Radian management informed on all matters relating to the program; and
- Review technical project outputs prior to issue.

RADIAN CORPORATION

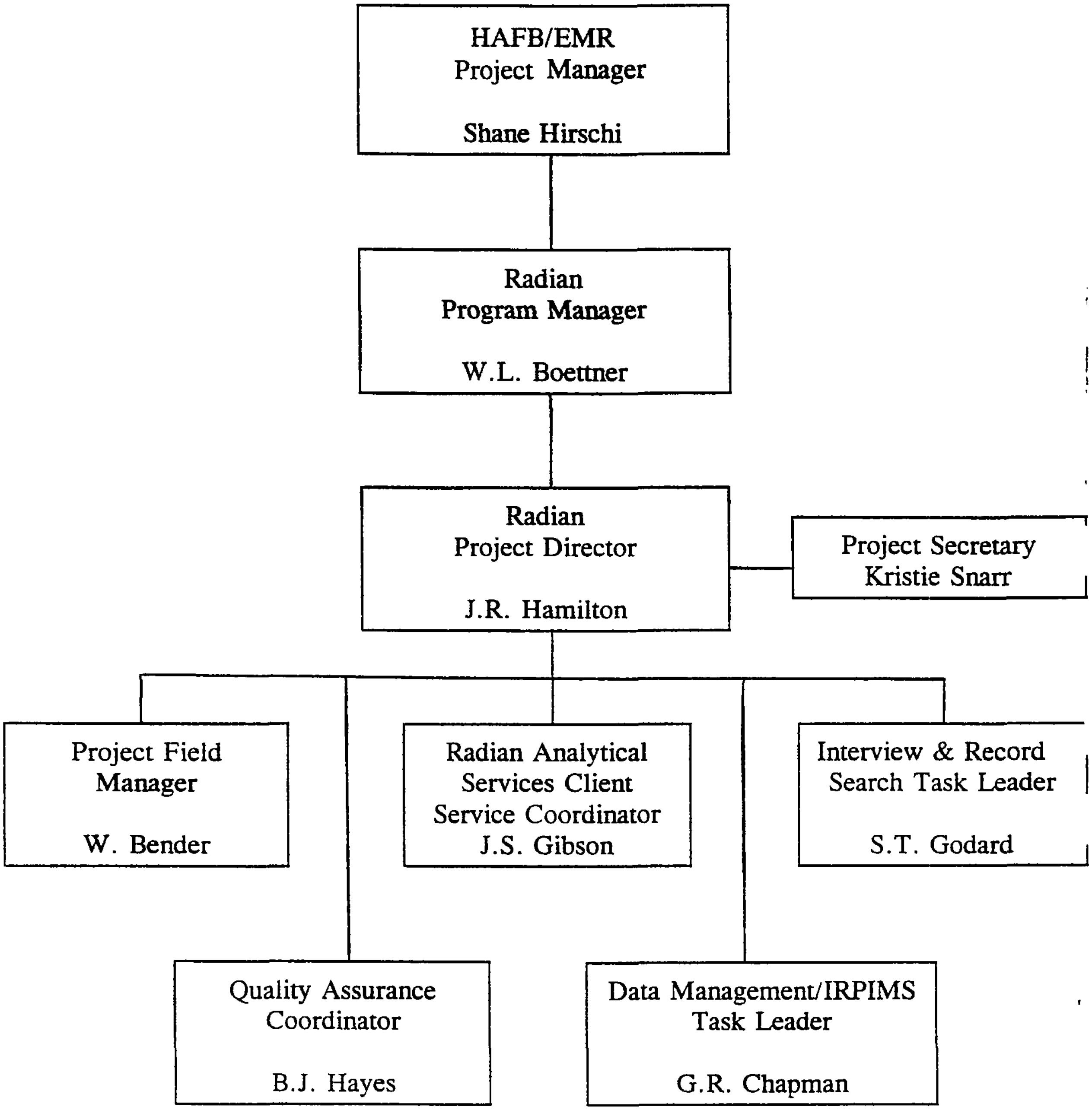


Figure 4-8. Wendover/UTTR Project Team Organization Chart

Mr. Jack Hamilton will serve as the Project Director for this project. In this capacity, he will be responsible for organizing and directing the technical activities of the project and for reporting the results of these activities. He will have day-to-day interaction with the Technical Staff. In the execution of these duties, Mr. Hamilton will:

- Establish technical objectives and assist the Program Manager in the preparation and review of work plans;
- Be responsible for responding to work plan revisions;
- Advise the Program Manager of technical progress, expenditures, program needs, potential problems, and recommended solutions;
- Assure technical quality of reports, memoranda, and other communications through review of results;
- Maintain contact with the Hill AFB/EMR Project Manager in areas that require decisions on technical matters; and
- Confer with the Radian Program Manager in the selection of supporting Technical Staff and be responsible for reviewing their performance through the program.

Ms. Barbara Hayes will serve as the Laboratory Quality Assurance Coordinator (LQAC). In this role, she will be responsible for development and execution of QA activities in all phases of the project, including test plan design, execution, data reduction, and reporting. Her responsibilities will include:

- Coordinating any external QA audit activities requested by the client;
- Serving as an in-house consultant to the Project Field Manager and Task Leader(s) in defining data quality goals or requirements and in development of a project-specific, internal quality control system which is responsive to these goals;
- Coordinating preparation of the project quality assurance documents which document the project-specific policies, organization, objectives, functional activities, and specific QA and QC procedures and activities designed to achieve data quality goals or requirements;

- Providing independent review of the project approach, methods, and experimental design;

- Providing the mechanism whereby quality assurance problems may be brought to the immediate attention of the Project Director and Program Manager or, if warranted, may be brought directly to the attention of the Vice President of the Technical Staff through the Quality Assurance Director, for implementation of corrective action; and

- Documenting the results of all QA/QC activities in reports to Radian management and to clients.

The Project Field Manager, Mr. Bill Bender, will be responsible for all on-site activities, including well installation, sample collection, field analyses, chain of custody, and reporting.

General responsibilities of Task Leaders include:

- Responsibility for ensuring that deliverables required for their task are delivered on schedule and within budget;

- Coordination of day-to-day activities of project team members working on their task;

- Maintaining close contact with the Project Field Manager so that schedule, budget, and/or technical problems are addressed in a timely manner;

- Coordination of day-to-day QC activities required for their respective tasks as part of the internal QC system;

- Ensuring compliance with all QC acceptance criteria and health and safety guidelines as specific in the QA Plan and Health and Safety Plan, respectively; and

- Keeping the QA Coordinator and Project Director advised of any quality problems which arise.

5.0 QUALITY ASSURANCE/QUALITY CONTROL

This section describes the Quality Assurance (QA) and Quality Control (QC) protocols to be used during the Preliminary Assessment Site Investigation (PA/SI) for the Wendover Air Force Auxiliary Field (AFAF). No invasive testing will be performed at the Utah Test and Training Range (UTTR).

5.1 Introduction

These QA/QC protocols have been prepared for work to be performed during the investigation at Wendover AFAF under Contract F-42650-92-D-0007, Delivery Order No. 5002. The purpose of the current work at Wendover AFAF is to perform a PA/SI of the landfill, V1 rocket launch site, salvage yard, gas dispensing station, and additional sites in the UTTR.

The investigation of Wendover AFAF will be conducted to accomplish the data gathering and evaluation stages of a PA/SI investigation. Planning for this investigation is based on the Statement of Work (SOW) provided by Hill AFB EMR.

These QA/QC protocols provide instructions, specifications, and procedures for the performance of field and laboratory activities conducted by Radian employees and their subcontractors. Radian Analytical Services is a certified laboratory to conduct analytical work according to Utah Department of Health Standards. Changes or modifications to this plan will require the approval of the U.S. Environmental Protection Agency (EPA), the Utah Department of Environmental Quality (UDEQ), the Wendover AFAF Project Manager, and the Radian Project Director.

5.2 Project Description

Radian will complete the following major tasks to fulfill the requirements of the SOW under Delivery Order 5002:

- Work Plan and Health and Safety Plan

These documents will be used as a guide for conducting the PA/SI at the Wendover AFAF site. These protocols describe the procedures to be followed to ensure that valid data are generated from the groundwater and soil sampling conducted during the Wendover AFAF PA/SI.

5.3 Data Quality Objectives

Data quality objectives for the Wendover AFAF PA/SI will be:

- To collect sufficient samples of soil and groundwater to determine if contamination exists and if further investigation is warranted;
- To collect and analyze samples under controlled situations according to standard methods; and
- To provide analytical results that may be compared to EPA SW-846 standards in terms of known precision and accuracy.

Measurement of data representiveness is a function of a sampling strategy and will be achieved using the procedures discussed in Section 4.0 of this document. The quality of analytical results is a function of the analytical system and will be achieved through the use of standard methods and the quality control system discussed in this section. Estimates of bias and imprecision for environmental samples will be determined from quality control samples discussed in this section.

5.3.1 Quality Control Procedures

A quality control (QC) program will be used, by Radian Corporation and subcontractors, to ensure that data quality objectives are met on the Wendover AFAF project.

A quality assurance (QA) program will be used by Radian Corporation to ensure data quality objectives are met. Quality control efforts are two-fold. First, they will provide the mechanism for ongoing control and evaluation of measurement data quality throughout the course of the project (i.e., system capability). Second, they will specify quality control data to be used to define natural-matrix data quality for various measurement parameters, in terms of precision and accuracy. Control of measurement data quality (i.e., control of error sources that affect data quality) is possible for sample collection and analysis. However, matrix interference, or non-homogeneity, is not amenable to control and thus imprecision or bias due to these natural sources of error must be estimated from QC samples.

For the Wendover AFAF, sample collection error will be controlled through the use of standard sample collection methods and field logbooks. Sample analysis error will be controlled through the use of standard analytical methods, performed on a capable analytical system, with quality control (QC) efforts as specified in the respective methods. Natural matrix error will be estimated by standard QC methods such as matrix spikes and field duplicates.

5.3.2 Quality Assurance Audits

The purpose of a quality assurance audit is to provide an objective, independent assessment of a measurement effort. It ensures that the laboratory's data generating, data gathering, and measurement activities produce reliable and useful results. Cases can occur in which inadequacies are identified in the measurement system. In such cases, audits provide the mechanism for implementing corrective action.

Quality assurance audits play an important role in an overall QA/QC program. This section describes the role of the QA auditor and the nature of quality assurance audits.

A quality assurance auditor is the person who designs and/or performs QA performance and systems audits. Since QA audits represent, by definition, independent assessments of a measurement system and associated data quality, the auditor must be functionally independent of the measurement effort to ensure objectivity. However, the auditor must be familiar enough with the objectives, principles, and procedures of the measurement efforts to be able to perform a thorough and effective evaluation of the measurement system. Especially important is the ability to identify components of the system that are critical to overall data quality. For this reason, the audit focuses heavily upon those elements. The auditor's technical background and experience should also provide a basis for appropriate audit standard selection, audit design, and data interpretation.

Quality assurance audits may include both internal and external audits. External audits are those conducted by an independent organization or technical support group and may include participation in interlaboratory comparison studies and certification testing. Internal audits are conducted by laboratory QA personnel.

The following paragraphs describe the purpose of several types of audits and identify the questions that are, and are not, addressed by each type of audit.

Technical Systems Audits

A technical systems audit is an on-site, qualitative review of the various aspects of a total sampling and/or analytical system. It is an assessment of overall effectiveness. It represents an objective and insightful evaluation of a set of interactive systems with respect to strengths, deficiencies, and potential areas of concern. Typically, the audit consists of observations and documentation of all aspects of the measurement effort.

Technical systems audits should be based on the approved QA/QC protocols. These audits review questions regarding:

- Calibration procedures and documentation;

- Completeness of data forms, notebooks, and other reporting requirements;
- Data review and validation procedures;
- Data storage, filing, and recordkeeping procedures;
- Sample custody procedures;
- Quality control procedures and documentation;
- Operating conditions of facilities and equipment;
- Documentation of maintenance activities; and
- Systems and operations overview.

Detailed systems audit checklists may be prepared prior to each audit. The checklist delineates the critical aspects of each methodology and measurement system, and is used by auditors to document all observations. The checklists are based on audit criteria specified by the Quality Assurance Officer (QAO) and the applicable QA/QC protocols.

Technical Systems Audits do not answer quantitative questions about the measurement system. The organization's policies regarding the role of Quality Assurance are not answered. Concerns involving assessments of the data quality indicators are also not addressed.

Performance Evaluation Audits

The purpose of performance evaluation audits is to quantitatively assess the measurements data quality. These audits provide a direct evaluation of the various measurement systems' capabilities to generate quality data. This is accomplished by challenging the measurement system with accepted reference standards. These reference standards may be submitted to the laboratory as if they were additional field samples; consequently, providing an evaluation without the laboratory being aware of the audit.

Performance evaluation audits answer questions regarding the following:

- Accuracy and precision of the measurement system;
- The quality control data as compared to the actual data collected;
- The measurement system as a function of established control limits; and
- Significant deviations of precision and accuracy over time.

Although the answers to these questions will help determine when a system is out of control, questions as to the appropriate corrective action may not always be evident. Questions regarding qualitative issues, such as management policies, sample custody procedures, recordkeeping, and data handling systems are not addressed in a performance evaluation audit.

Audits of Data Quality

The purpose of data quality audits is to assess data quality indicators. Audits for data quality provide information required to characterize data quality by answering questions regarding:

- Adequacy of data recording and transfer;
- Precision and bias of resultant data;
- Adequacy of data calculation, generation, and processing;
- Documentation of procedures; and
- Identification of data quality indicators to inform users of limitations and applicability.

Audits of data quality answer questions about whether data collection efforts need modification, and whether the use and documentation of quality control procedures are adequate. Audits of data quality do not, however, answer technical questions such as those concerning the operating conditions of facilities and equipment.

Post-Audit Debriefing

Following each audit, a post-audit debriefing session is conducted. The purpose of this session is to discuss preliminary audit results with the audit participants. If the audit reveals a critical deficiency, recommendations for corrective action should be presented. The debriefing session is followed by a detailed audit report that identifies areas of concern and recommendations for corrective actions.

5.3.3 Analytical Capability

QA efforts to control measurement error require that the analytical system be capable, in control, and appropriately sensitive for all analyses. System capability, in terms of accuracy and precision, may be documented by reporting system QC data (e.g., continuing calibration, laboratory control samples (LCS), method spikes, etc.). System capability, in terms of sensitivity, may be documented through the use of maximum detection limits for system blanks (i.e., reagent, system, and method blanks) and calibration standards. System control may be documented through the use of control charts or other statistical methods for an indication of system performance over time.

Precision and accuracy objectives, in terms of maximum allowable imprecision and inaccuracy, for the various measurement parameters associated with site characterization efforts, are presented in Tables 5-1 and 5-2 for groundwater and soil analyses, respectively. Data capture objectives for all constituents is 90 percent. Precision values presented in the table represent a measure of variability for replicate measurements of the same parameter in clean-matrix, laboratory QC samples, expressed in terms of the coefficient of variation (CV,

Table 5-1

Estimated Precision and Accuracy Objectives for Groundwater Samples

Parameter	Method	Precision [a]	Accuracy [b]
Alkalinity	EPA 310.1	20%	±15%
Chloride	EPA 300	20%	±20%
Cyanide	SW-846:9010	20%	±20%
Fluoride	EPA 340.2	10%	±15%
Nitrate/Nitrite	EPA 353.1	20%	±15%
Sulfate	EPA 300	20%	±20%
Metals [c]	SW-846:6010 ICPES	20%	±20%
Antimony	SW-846:7041 Furnace AA	20%	±20%
Arsenic	SW-846:7060 Furnace AA	20%	±25%
Cadmium	SW-846:7131 Furnace AA	20%	±25%
Lead	SW-846:7421 Furnace AA	20%	±25%
Mercury	SW-846:7470 Cold Vapor AA	20%	±20%
Selenium	SW-846:7740 Furnace AA	20%	±25%
Thallium	SW-846:7841 Furnace AA	20%	±25%
Semivolatile Organic Compounds	SW-846:8270 GC/MS	50%	See Method 8270, Table 6.
Volatile Organic Compounds	SW-846:8240 GC/MS	30%	See Method 8240, Table 6.

Table 5-1

(Continued)

Parameter	Method	Precision [a]	Accuracy [b]
PCBs	SW-846:8080 GC/ECD	50%	See Method 8080, Table 3
Polynuclear Aromatic Hydrocarbons	SW-846:8310 HPLC	50%	See Method 8310, Table 3
Phenols (Pentachlorophenol)	SW-846:8040 GD/FID	50%	See Method 8040, Table 3
Halogenated Volatile Organics (Vinyl Chloride)	SW-846:8010 GC/Hall	30%	See Method 8010, Table 3

[a] Coefficient of variation (relative standard deviation) for replicate analytical determinations (exclusive of sampling variability). The average CV for a series of LCS or continuing calibration samples will be compared to these objectives.

[b] Total error for a single measurement in a clean, laboratory-controlled, matrix, including both systematic error (bias) and random error (variability due to imprecision), expressed as a percentage of the measured value. The average RPD for a series of LCS or continuing calibration samples will be compared to these objectives.

[c] ICPES metals: Aluminum, barium, beryllium, calcium, chromium, cobalt, copper, iron, magnesium, manganese, nickel, potassium, silver, sodium, vanadium, and zinc.

Table 5-2

Estimated Precision and Accuracy Objectives for Soil Samples

Parameter	Method	Precision [a]	Accuracy [b]
Metals [c]	SW-846:6010 ICPES	20%	±20%
Arsenic	SW-846:7060 Graphite Furnace AA	20%	±25%
Lead	SW-846:7421 Graphite Furnace AA	20%	±25%
Mercury	SW-846:7471 Cold Vapor AA	20%	±25%
Selenium	SW-846:7471 Graphite Furnace AA	20%	±25%
Thallium	SW-846:7841 Graphite Furnace AA	20%	±25%
TCLP Metals [d]	SW-846:1311/6010 and 1311/7470	20%	±25%
TCLP Volatiles [e]	SW-846:1311/8240	30%	See Method 8240, Table 6
Volatile Organic Compounds	SW-846:8240 GC/MS	50%	See Method 8240, Table 6
Semivolatile Organic Compounds	SW-846:8270 GC/MS	50%	See Method 8270, Table 6
Pesticides/PCBs	SW-846:8080 GC/ECD	50%	See Method 8080, Table 3
Cyanide	SW-846:9010	20%	±20%
Soil Moisture	ASTM D2216	Not specified	Not specified
Atterburg Limits	ASTM 4318	Not specified	Not specified
Sieve Analysis	ASTM D422	Not specified	Not specified

Table 5-2

(Continued)

Parameter	Method	Precision [a]	Accuracy [b]
Permeability (Saturated Tri-Axl)	ASTM D5084	Not specified	Not specified
Organic Content	ASTM D2974	Not specified	Not specified
Cation Exchange Capacity	SW-846:9080/9081	Not specified	Not specified
Vertical Hydraulic Conductivity	SW-846:9100	Not specified	Not specified

[a] Coefficient of variation (CV or relative standard deviation) for replicate analytical determinations (exclusive of sampling variability). The average CV for a series of LCS or continuing calibration samples will be compared to these objectives.

[b] Total error for a single measurement in a clean, laboratory-controlled matrix, including both systematic error (bias) and random error (variability due to imprecision), expressed as a percentage of the measured value. Average RPD for a series of LCS or continuing calibration samples will be compared to these objectives.

[c] ICPES metals: Aluminum, barium, beryllium, calcium, chromium, cobalt, copper, iron, magnesium, manganese, nickel, potassium, silver, sodium, vanadium, and zinc.

[d] TCLP metals: arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver.

[e] TCLP volatiles: benzene, carbon tetrachloride, chlorobenzene, chloroform, 1,2-dichloroethane, 1,1-dichloroethylene, methyl ethyl ketone, tetrachloroethylene, trichloroethylene, and vinyl chloride.

or relative standard deviation). CVs compared to precision objectives in Tables 5-1 and 5-2 are calculated from data such as continuing calibration results and LCS results. Accuracy values for clean matrix, laboratory samples include components of both random error (i.e., variability due to imprecision) and systematic error (i.e., bias), and thus reflect the total analytical error for a given measurement, expressed as a percentage of the true value. The average relative percent difference between true and measured concentrations in continuing calibration and LCS samples may be compared to accuracy objectives in Tables 5-1 and 5-2. The basis for these estimates are described in the methods. It is expected that the analytical laboratory will be able to document that the QA/QC procedures in each standard method was followed for all analytical work. Accuracy and precision estimates for samples in a natural matrix (which is much more difficult from an analytical standpoint) would not be expected to be as accurate or precise.

Sample detection limits must be sensitive to concentrations at or below the detection limits specified by each method. Clean matrix detection limits are presented in Table 5-3. Because samples must commonly be diluted due to concentrations of target, or non-target, constituents exceeding calibration limits, natural sample detection limits may be greater. Unless custom analytical services are requested, detection limits greater than action levels will be considered acceptable and the resulting data complete. The analytical laboratory must document what prompted the higher detection limits and the maximum concentrations that were allowable on the calibration curve. This level of effort is required on a sample-by-sample basis and may not be applied to batches of samples.

5.4 Field Procedures

Field procedures for the Wendover AFAF PA/SI are presented in detail in Section 4.0 of this document.

Table 5-3

Analytical Methods, Requested Detection Limits, and Maximum Contaminant Levels

Parameter	Analysis		Reporting Detection Limits [a]		Maximum Contaminant Level	
	Technique	Method (Water/Soil)	Water (mg/L)	Soil (mg/Kg)	MCL [b] (mg/L)	Utah MCL [c] (mg/L)
GENERAL						
Alkalinity	Titrimetric	EPA:310.1	1	N/A	--	--
Chloride	IC	EPA:300	0.02	N/A	--	--
Cyanide	Colorimetric	SW-846:9010	0.004	0.4	0.2 [d]	--
Fluoride	ISE	EPA:340.2	0.1	N/A	4.0	4.0
Nitrate/Nitrite	Colorimetric	EPA:353.1	0.02	N/A	10	10
Sulfate	IC	EPA:300	0.05	N/A	--	1000
METALS						
Aluminum	ICPES	SW-846:6010	0.2	20	--	--
Antimony	GFAA/ICPES	SW-846:7041/6010	0.007	10	0.006	--
Arsenic	GFAA	SW-846:7060	0.004	0.4	0.05	0.05
Barium	ICPES	SW-846:6010	0.01	1.0	2	1
Beryllium	ICPES	SW-846:6010	0.001	0.2	0.004	--
Cadmium	GFAA/ICPES	SW-846:7131/6010	0.001	0.5	0.005	0.01
Calcium	ICPES	SW-846:6010	1	100	--	--
Chromium	ICPES	SW-846:6010	0.01	1.0	0.1	0.05
Cobalt	ICPES	SW-846:6010	0.01	1.0	--	--
Copper	ICPES	SW-846:6010	0.02	2.0	1.3	--
Iron	ICPES	SW-846:6010	0.04	4.0	--	--
Lead	GFAA	SW-846:7421	0.003 [e]	0.3	0.05	0.05
Magnesium	ICPES	SW-846:6010	1	100	--	--
Manganese	ICPES	SW-846:6010	0.01	1.0	--	--
Mercury	CVAA	SW-846:7470/7471	0.0002	0.02	0.002	0.002
Nickel	ICPES	SW-846:6010	0.02	2.0	0.1 [d]	--
Potassium	ICPES	SW-846-6010	3	300	--	--
Selenium	GFAA	SW-846:7740	0.001	1.0	0.05	0.01
Silver	ICPES	SW-846:6010	0.01	1.0	--	0.05
Sodium	ICPES	SW-846:6010	1	100	--	--
Thallium	GFAA	SW-846:7841	0.005	10	0.002 [d]	--
Vanadium	ICPES	SW-846:6010	0.02	20	--	--

Table 5-3

(Continued)

Parameter	Analysis: Technique	Analysis: Method (Water/Soil)	Reporting Detection Limits[a]: Water (mg/L)	Reporting Detection Limits[a]: Soil (mg/Kg)	Maximum Contaminant Level: MCL[b] (mg/L)	Maximum Contaminant Level: Utah MCL[c] (mg/L)
Zinc	ICPES	SW-846:6010	0.02	20	--	--

Parameter	Analysis: Technique	Analysis: Method (Water/Soil)	Reporting Detection Limits[a]: Water (µg/L)	Reporting Detection Limits[a]: Soil (µg/Kg)	Maximum Contaminant Level: MCL[b] (µg/L)	Maximum Contaminant Level: Utah MCL[c] (µg/L)
VOLATILE ORGANICS						
Acetone	GC/MS	SW-846:8240[e]	100	2000	--	--
Benzene	GC/MS	SW-846:8240	5	100	5	5
Bromodichloromethane	GC/MS	SW-846:8240	5	100	--	--
Bromoform	GC/MS	SW-846:8240	5	100	--	--
Bromomethane	GC/MS	SW-846:8240	10	200	--	--
Carbon disulfide	GC/MS	SW-846:8240	5	100	--	--
Carbon tetrachloride	GC/MS	SW-846:8240	5	100	5	5
Chlorobenzene	GC/MS	SW-846:8240	5	100	--	--
Chloroethane	GC/MS	SW-846:8240	10	200	--	--
2-Chloroethyl Vinyl Ether	GC/MS	SW-846:8240	10	200	--	--
Chloroform	GC/MS	SW-846:8240	5	100	--	--
Chloromethane	GC/MS	SW-846:8240	10	200	--	--
Dibromochloromethane	GC/MS	SW-846:8240	5	100	--	--
1,2-Dichloroethane	GC/MS	SW-846:8240	5	100	5	5
trans-1,2-Dichloroethene	GC/MS	SW-846:8240	5	100	100	--
1,1-Dichloroethane	GC/MS	SW-846:8240	5	100	--	--
1,1-Dichloroethene	GC/MS	SW-846:8240	5	100	7	7
1,2-Dichloropropane	GC/MS	SW-846:8240	5	100	5	--
cis-1,3-Dichloropropene	GC/MS	SW-846:8240	5	100	--	--
trans-1,3-Dichloropropene	GC/MS	SW-846:8240	5	100	--	--
Ethyl benzene	GC/MS	SW-846:8240	5	100	700	--
2-Hexanone	GC/MS	SW-846:8240	50	1000	--	--
Methylene chloride	GC/MS	SW-846:8240	5	100	--	--
2-Butanone (MEK)	GC/MS	SW-846:8240	100	2000	5[g]	--
4-Methyl-2-pentanone	GC/MS	SW-846:8240	50	1000	--	--
Styrene	GC/MS	SW-846:8240	5	100	100	--
1,1,2,2-Tetrachloroethane	GC/MS	SW-846:8240	5	100	--	--

Table 5-3

(Continued)

Parameter	Analysis		Reporting Detection Limits[a]		Maximum Contaminant Level	
	Technique	Method (Water/Soil)	Water (µg/L)	Soil (µg/Kg)	MCL[b] (µg/L)	Utah MCL[c] (µg/L)
Tetrachloroethene	GC/MS	SW-846:8240	5	100	5	--
1,1,1-Trichloroethane	GC/MS	SW-846:8240	5	100	200	200
1,1,2-Trichloroethane	GC/MS	SW-846:8240	5	100	5[d]	--
Trichloroethene	GC/MS	SW-846:8240	5	100	5	5
Toluene	GC/MS	SW-846:8240	5	100	1000	--
Vinyl Acetate	GC/MS	SW-846:8240	50	5000	--	--
Vinyl Chloride	GC/Hall-GC/MS	SW-846:8010/8240	0.3	200	2	2
Xylenes (total)	GC/MS	SW-846:8240	5	100	10,000	--
SEMIVOLATILE ORGANICS						
Anthracene	GC/MS	SW-846:8270	10	660	--	--
Benzo(a)anthracene	HPLC-GC/MS	SW-846:8310/8270	0.01	660	0.1[d]	--
Benzo(b)fluoranthene	HPLC-GC/MS	SW-846:8310/8270	0.02	660	0.2[d]	--
Benzo(k)fluoranthene	HPLC-GC/MS	SW-846:8310/8270	0.02	660	0.2[d]	--
Benzo(a)pyrene	HPLC-GC/MS	SW-846:8310/8270	0.02	660	0.2[d]	--
bis(2-Ethylhexyl)-phthalate	GC/MS	SW-846:8270	10	660	--	--
Butyl benzyl phthalate	GC/MS	SW-846:8270	10	660	100	--
Chrysene	HPLC-GC/MS	SW-846:8310/8270	0.15	660	0.2[d]	--
Dibenz(a,h)anthracene	HPLC-GC/MS	SW-846:8310/8270	0.03	660	0.3[d]	--
1,2-Dichlorobenzene	GC/MS	SW-846:8270	10	660	600	--
1,3-Dichlorobenzene	GC/MS	SW-846:8270	10	660	600	--
1,4-Dichlorobenzene	GC/MS	SW-846:8270	10	660	75	75
Dimethylphthalate	GC/MS	SW-846:8270	10	660	--	--
Diethylphthalate	GC/MS	SW-846:8270	10	660	--	--
Di-n-butylphthalate	GC/MS	SW-846:8270	10	660	--	--
Di-noctylphthalate	GC/MS	SW-846:8270	10	660	--	--
Fluoranthene	GC/MS	SW-846:8270	10	660	--	--
2-Methyl naphthalene	GC/MS	SW-846:8270	10	660	--	--
Naphthalene	GC/MS	SW-846:8270	10	660	--	--
Phenanthrene	GC/MS	SW-846:8270	10	660	--	--
Pyrene	GC/MS	SW-846:8270	10	660	--	--
2,4-Dimethylphenol	GC/MS	SW-846:8270	10	660	--	--
2,4-Dinitrophenol	GC/MS	SW-846:8270	50	3300	--	--

Table 5-3

(Continued)

Parameter	Analysis		Reporting Detection Limits [a]		Maximum Contaminant Level	
	Technique	Method (Water/Soil)	Water (µg/L)	Soil (µg/Kg)	MCL [b] (µg/L)	Utah MCL [c] (µg/L)
4-Nitrophenol	GC/MS	SW-846:8270	50	3300	–	–
Phenol	GC/MS	SW-846:8270	10	660	–	–
Acenaphthene	GC/MS	SW-846:8270	10	660	–	–
Acenaphthylene	GC/MS	SW-846:8270	10	660	–	–
Benzoic acid	GC/MS	SW-846:8270	50	3300	–	–
Benzo(g,h,i)perylene	GC/MS	SW-846:8270	10	660	–	–
Benzyl Alcohol	GC/MS	SW-846:8270	20	1300	–	–
4-Bromophenyl phenyl ether	GC/MS	SW-846:8270	10	660	–	–
4-Chloroaniline	GC/MS	SW-846:8270	20	1300	–	–
4-Chloro-3-methylphenol	GC/MS	SW-846:8270	20	1300	–	–
bis(2-Chloroisopropyl)ether	GC/MS	SW-846:8270	10	660	–	–
bis(2-Chloroethyl)ether	GC/MS	SW-846:8270	10	660	–	–
2-Chloronaphthalene	GC/MS	SW-846:8270	10	660	–	–
2-Chlorophenol	GC/MS	SW-846:8270	10	660	–	–
bis(2-Chloroethoxy)methane	GC/MS	SW-846:8270	10	660	–	–
4-Chlorophenyl phenyl ether	GC/MS	SW-846:8270	10	660	–	–
Dibenzofuran	GC/MS	SW-846:8270	10	660	–	–
2,4-Dichlorophenol	GC/MS	SW-846:8270	10	660	–	–
3,3-Dichlorobenzidine	GC/MS	SW-846:8270	20	1300	–	–
2,4-Dinitrotoluene	GC/MS	SW-846:8270	10	660	–	–
2,6-Dinitrotoluene	GC/MS	SW-846:8270	10	660	–	–
4,6-Dinitro-2-methylphenol	GC/MS	SW-846:8270	50	3300	–	–
Fluorene	GC/MS	SW-846:8270	10	660	–	–
Hexachlorobenzene	GC/MS	SW-846:8270	10	660	1 [d]	–
Hexachlorocyclopentadiene	GC/MS	SW-846:8270	10	660	50 [d]	–
Hexachloroethane	GC/MS	SW-846:8270	10	660	–	–
Hexachlorobutadiene	GC/MS	SW-846:8270	10	660	–	–
Indeno(1,2,3-c,d)pyrene	HPLC-GC/MS	SW-846:8310/8270	0.04	660	0.4 [d]	–
Isophorone	GC/MS	SW-846:8270	10	660	–	–
2-Methylphenol	GC/MS	SW-846:8270	10	660	–	–
4-Methylphenol	GC/MS	SW-846:8270	10	660	–	–
2-Nitroaniline	GC/MS	SW-846:8270	50	3300	–	–

Table 5-3

(Continued)

Parameter	Analysis		Reporting Detection Limits[a]		Maximum Contaminant Level	
	Technique	Method (Water/Soil)	Water (µg/L)	Soil (µg/Kg)	MCL[b] (µg/L)	Utah MCL[c] (µg/L)
3-Nitroaniline	GC/MS	SW-846:8270	50	3300	–	–
4-Nitroaniline	GC/MS	SW-846:8270	50	3300	–	–
Nitrobenzene	GC/MS	SW-846:8270	10	660	–	–
2-Nitrophenol	GC/MS	SW-846:8270	10	660	–	–
n-Nitroso-di-n-propylamine	GC/MS	SW-846:8270	10	660	–	–
n-Nitrosodiphenylamine	GC/MS	SW-846:/8270	10	660	–	–
Pentachlorophenol	GC/FID-GC/MS	SW-846:8040/8270	1	3300	1	–
1,2,4-Trichlorobenzene	GC/MS	SW-846:8270	10	660	70	–
2,4,5-Trichlorophenol	GC/MS	SW-846:8270	50	3300	–	–
2,4,6-Trichlorophenol	GC/MS	SW-846:8270	10	660	–	–
ORGANOCHLORINE PESTICIDES AND PCBs						
Aldrin	GC/ECD	SW-846:8080	0.04	1	–	–
alpha-BHC	GC/ECD	SW-846:8080	0.03	1	–	–
beta-GHC	GC/ECD	SW-846:8080	0.06	1	–	–
delta-BHC	GC/ECD	SW-846:8080	0.09	1	–	–
gamma-BHC (Lindane)	GC/ECD	SW-846:8080	0.04	1	0.2	–
Chlordane (technical)	GC/ECD	SW-846:8080	0.14	5	2	–
4,4'-DDD	GC/ECD	SW-846:8080	0.11	1	–	–
4,4'-DDE	GC/ECD	SW-846:8080	0.04	1	–	–
4,4'-DDT	GC/ECD	SW-846:8080	0.12	2	–	–
Dieldrin	GC/ECD	SW-846:8080	0.02	1	–	–
Endosulfan I	GC/ECD	SW-846:8080	0.14	1	–	–
Endosulfan II	GC/ECD	SW-846:8080	0.04	3	–	–
Endosulfan sulfate	GC/ECD	SW-846:8080	0.66	5	–	–
Endrin	GC/ECD	SW-846:8080	0.06	1	2	–
Endrin aldehyde	GC/ECD	SW-846:8080	0.23	2	–	–
Heptachlor	GC/ECD	SW-846:8080	0.03	1	0.4	–
Heptachlor epoxide	GC/ECD	SW-846:8080	0.83	1	0.2	–
Methoxychlor	GC/ECD	SW-846:8080	0.05	5	40	–
Toxaphene	GC/ECD	SW-846:8080	0.5	50	3	–
PCB-1016	GC/ECD	SW-846:8080	0.1	10	0.05	–

Table 5-3

(Continued)

Parameter	Analysis: Technique	Analysis: Method (Water/Soil)	Reporting Detection Limits[a]: Water (µg/L)	Reporting Detection Limits[a]: Soil (µg/Kg)	Maximum Contaminant Level: MCL[b] (µg/L)	Maximum Contaminant Level: Utah MCL[c] (µg/L)
PCB-1221	GC/ECD	SW-846:8080	0.1	1.0	0.05	--
PCB-1232	GC/ECD	SW-846:8080	0.2	20	0.05	--
PCB-1242	GC/ECD	SW-846:8080	0.1	10	0.05	--
PCB-1248	GC/ECD	SW-846:8080	0.1	10	0.05	--
PCB-1254	GC/ECD	SW-846:8080	0.2	20	0.05	--
PCB-1260	GC/ECD	SW-846:8080	1.0	20	0.05	--
GEOTECHNICAL						
Atterburg Limits	Geotechnical	ASTM 4318	N/A	--	--	--
Sieve Analysis	Geotechnical	ASTM D422	N/A	--	--	--
Permeability (Saturated triaxl)	Geotechnical	ASTM D5084	N/A	10^{-11} cm/sec	--	--
Organic Content	Geotechnical	ASTM D2974	N/A	0.1%	--	--
Cation Exchange Capacity	Geotechnical	SW-846:9080/9081	N/A	--	--	--
Vertical Hydraulic Conductivity	Geotechnical	SW-846:9100	N/A	--	--	--
Soil Moisture	Gravimetric	ASTM D2216	N/A	0.1%	--	--

Parameter	Analysis: Technique	Analysis: Method (Water/Soil)	Reporting Detection Limits[a]: Water (mg/L)	Reporting Detection Limits[a]: Leachate (mg/Kg)	Maximum Contaminant Level: TCLP Criteria (mg/L)	Maximum Contaminant Level: Utah MCL[c] (mg/L)
TCLP Metals						
Arsenic	ICPES	SW-846:1311/6010	N/A	0.3	5	N/A
Barium	ICPES	SW-846:1311/6010	N/A	0.01	100	N/A
Cadmium	ICPES	SW-846:1311/6010	N/A	0.005	1	N/A
Chromium	ICPES	SW-846:1311/6010	N/A	0.01	5	N/A
Lead	ICPES	SW-846:1311/6010	N/A	0.05	5	N/A
Mercury	CVAA	SW-846:1311/7470	N/A	0.002	0.2	N/A
Selenium	ICPES	SW-846:1311/6010	N/A	0.3	1	N/A
Silver	ICPES	SW-846:1311/6010	N/A	0.01	5	N/A
TCLP VOLATILES						
Benzene	GC/MS	SW-846:1311/8240	N/A	0.005	0.5	N/A
Carbon tetrachloride	GC/MS	SW-846:1311/8240	N/A	0.005	0.5	N/A
Chlorobenzene	GC/MS	SW-846:1311/8240	N/A	0.005	100	N/A
Chloroform	GC/MS	SW-846:1311/8240	N/A	0.005	6	N/A

Table 5-3

(Continued)

Parameter	Analysis		Reporting Detection Limits[a]		Maximum Contaminant Level	
	Technique	Method (Water/Soil)	Water (mg/L)	Leachate (mg/Kg)	TCLP Criteria (mg/L)	Utah MCL[c] (mg/L)
1,2-Dichloroethane	GC/MS	SW-846:1311/8240	N/A	0.005	0.5	N/A
1,1-Dichloroethylene	GC/MS	SW-846:1311/8240	N/A	0.005	0.7	N/A
Methyl ethyl ketone	GC/MS	SW-846:1311/8240	N/A	0.1	200	N/A
Tetrachloroethylene	GC/MS	SW-846:1311/8240	N/A	0.005	0.7	N/A
Trichloroethylene	GC/MS	SW-846:1311/8240	N/A	0.005	0.5	N/A
Vinyl chloride	GC/MS	SW-846:1311/8240	N/A	0.01	0.2	N/A

[a] Reporting Detection Limit (RDL) is the minimum concentration of a substance that is reported. Method Detection Limit (MDL) for metals are approximately 2 to 5 times lower than the RDL and the MDL for organics are approximately 10 times lower than the RDL. To determine if groundwater meet applicable drinking water MCLs and Utah MCL requirements, Radian will report values greater than the MDL but less than the RDL with a J flag. Method Detection Limits are highly matrix dependent and may not always be achievable.

[b] Federal Drinking Water Standards Maximum Contaminant Levels (MCL), Office of Drinking Water, USEPA. The MCL for lead is a project-specific reporting limit goal.

[c] State of Utah Maximum Contaminant Levels (MCL).

[d] Proposed on May 20, 1992.

[e] Groundwater samples analyzed by SW-846 Method 8240 will utilize a 25 mL sample purging volume. Increasing the sample from 5 mL to 25 mL will result in reducing the Reporting and Method Detection Limits by about a factor of 3.

[f] A 2 liter groundwater sample will be extracted for SW-846 Method 8270. This will result in reducing the Reporting and Method Detection Limits by about a factor of 2.

[g] The MCL stated for lead is a project specific reporting limit goal for Hill AFB OU 6.

IC	=	Ion Chromatography
IR	=	Infrared Spectrometry
ICPES	=	Inductively Coupled Plasma Emission Spectroscopy
ISE	=	Ion Selective Electrode
GFAA	=	Graphite Furnace Atomic Absorption
GVAA	=	Cold Vapor Atomic Absorption
GC/MS	=	Gas Chromatography/Mass Spectrometry
SW-846	=	Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, U.S. EPA, Office of Solid Waste and Emergency Response, November 1986, third edition.
EPA	=	Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020.
N/A	=	Not Applicable
GC/ECD	=	Gas Chromatography/Electron Capture Detector
GC/FID	=	Gas Chromatography/Flame Ionization Detector
HPLC	=	High Pressure Liquid Chromatography with ultraviolet (uv) and fluorescence detectors.
TCLP	=	Toxic Characteristic Leaching Procedure

5.5 Sample Custody

Custody is physical possession of a sample and storage of a sample in a secure area. Custody is typically considered in three parts: sample collection, laboratory, and final (evidence) files. All laboratory raw data and other supporting records will be maintained by the laboratory a minimum of five years. Field, or on-site logbooks, will be maintained by Radian a minimum of five years.

Sample custody procedures for this program are based on EPA-recommended protocols which emphasize careful documentation of sample collection and Table 5-3 transfer data. These protocols are detailed in the EPA Technical Enforcement Guidance Document (Section 4.4, OSWER-9950.1). The Supervising Geologist will be responsible for field team adherence to proper custody and documentation procedures for all sampling operations. To ensure that all of the important information pertaining to each sample is recorded, documentation procedures will be standardized. Preformatted field data and sample custody forms will be used to document the relevant information for each sample taken. A master sample logbook will be maintained on site for all samples collected. Field data and sample custody information will supplementally be backed up on a computerized data base system to facilitate retrieval and sample tracking. Specific documentation labels and procedures are discussed below.

5.5.1 Chain of Custody

Sample chain of custody involves documenting the handling of a sample from the time of collection to the time of final disposition. This section describes the procedures which will be used to accomplish chain of custody control.

Sample Labels

Each sample collected will immediately have a sample label (Figure 5-1) attached to the sample container. Sample labels are given a unique field sample number and serve to identify the sample by documenting the sample type, who took it, where it was taken, when it was taken, and the preservation method(s) used. These labels are completed with a water-proof ink pen and are affixed securely to the sample container. Transparent tape will be applied over the label to ensure that it will remain properly attached. QA/QC samples (blanks and duplicates) will be numbered in the same manner and will not be distinguishable by the laboratory from normal samples.

Chain of Custody Record

Sample custody will be documented using the form shown in Figure 5-2. Chain of custody records will be sequentially numbered to facilitate tracking of shipment of individual samples. After the water sample identification information is entered in the master logbook, it will be entered on the chain of custody form and shipped with the samples. The chain of custody form will accompany the samples throughout all analytical work to final disposition. The chain of custody record number will also be entered into the master log for each sample shipped.

A tampering indication seal (Figure 5-3) will be affixed to each sample cooler sent off site for sample analysis. This seal should remain intact until the cooler is opened at the appropriate laboratory.

Transfer of Custody and Shipment

The chain of custody forms are printed on three-part NCR (no carbon required) paper and distributed in the following manner:

RADIAN
CORPORATION

Field Number ____________________

Sample Type: ____________________

Client: ____________________

Location: ____________________

Preservative: ____________________

Sampler: ____________________

Date: ____________________

Comment: ____________________

6-89-31426

Figure 5-1. Radian Sample Label

RADIAN
CORPORATION

Chain of Custody Record

Page ____ of ____

PROJECT
SITE
COLLECTED BY *(Signature)*

FIELD SAMPLE I D	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	ANALYSES								REMARKS	SAM ID NO. *(for lab use only)*

REMARKS	RELINQUISHED BY:	DATE	TIME

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY:	DATE	TIME	TEMP°C	SEAL #	CONDITION
REMARKS:									

4-88-30337

Figure 5-2. Chain of Custody Form

ATTENTION:

BEFORE OPENING
NOTE IF CONTAINER
WAS TAMPERED WITH.

I.D. # ________________________________

ATTENTION:

BEFORE OPENING
NOTE IF CONTAINER
WAS TAMPERED WITH.

6-89-31426

Figure 5-3. Radian Custody Seal

- Original (white) - Sent to the laboratory with samples and completed and signed off when the sample is disposed of. The original copy is then returned to the Project file.

- Second Copy (yellow) - Sent to the laboratory with samples. This copy is retained by the laboratory when analyses are completed and the sample is disposed of.

- Third Copy (pink) - Retained by the Supervising Geologist when the sample is shipped to the laboratory for analysis.

Laboratory Custody Procedures

Each laboratory conducting analyses for this program will be required to use the described chain of custody forms to document the handling of each sample. Exception will be made only if the laboratory has an internal sample tracking system that satisfactorily documents continuous chain of custody. The laboratory will also be required to return a final copy of the chain of custody form when submitting the analytical results to the Project Director.

When analytical results are returned by the analytical laboratories, the Project Director or Supervising Geologist will date stamp the analytical results and annotate the sample master log to indicate receipt of sample results. The information recorded in the master log will be checked to ensure that complete analytical results have been reported. The laboratory will be notified if errors such as incorrect sample control numbers, incomplete lab analysis, or other incorrect or incomplete information are found. An amended report will then be requested in writing.

5.5.2 Documentation

Sample Identification

All samples received from the field are immediately assigned a sample control number by the laboratory. This number is unique to each individual sample and a label bearing the sample control number will be affixed to each container. The number will remain with the sample throughout the analysis and data entry procedures. Typically, the number sequence used for sample control numbers will include the month and year the sample was received by the laboratory. The final report will contain a listing of the field sample numbers and the corresponding laboratory sample numbers.

Logs

Sample Control Logs--A Master Sample Log (Figure 5-4) will be maintained for all samples collected. The Supervising Geologist will be responsible for ensuring that the Master Sample Log be properly filled out during sampling activities. The Master Sample Log will also be filled out prior to shipment of samples off site. Each sample will be assigned a unique identification number (field sample number); and a full description of the sample, its origin, and its disposition will be included in the master log entry.

Laboratory Logs--Analytical data will be recorded in bound, paginated laboratory notebooks. The Laboratory Analyst conducting the analysis will be responsible for maintaining the laboratory notebook. All notebook entries will be dated and initialed by the author. In addition to the analytical results, any reagent and standard preparation will be documented in a separate section of the appropriate analytical notebook. Typical information will include documentation of dates for preparation of stock solutions, manufacturers' lot numbers, preparation procedures, etc. Other media for recording analytical data will be acceptable if they have been approved by the Radian Project Director.

Master Sample Log
Wendover AFAF

Sample ID	Location	Matrix	Analyses	Date/Time Collected	Date/Time Shipped	Collector(s)	Comments

Figure 5-4. Master Sample Log

Copies of raw data, laboratory notes, chromatograms, stripchart recordings, and standard curves will be maintained in a central file for future inspection. Copies of instrument logs and maintenance records for the period of performance will also be available for review.

Corrections to Documentation

Corrections made to laboratory data and/or chain of custody and related documents (labels, logs, records, etc.) will be made by drawing a single line through the incorrect section and initialing and dating the action. In the event of such a correction, the Project Director will be immediately notified verbally and then in writing. The notification will include a description of the correction(s) made, when the correction was made, and the reason for the change.

5.5.3 Sample Handling, Packaging, and Shipping

The Supervising Geologist is responsible for properly packaging and shipping the samples to the laboratory. All pertinent Department of Transportation (DOT) shipping regulations will be followed. All samples will be collected according to EPA guidelines. The container size and type will vary based on the sample media and required analysis. Sample container, preservation, and holding time requirements are presented in Tables 5-4 and 5-5.

Packaging--If the water sample container is glass, a protective poly-net is placed over the container to protect it from breakage. The samples will be placed in an ice chest or other approved shipping container and enough ice placed in the ice chest to maintain the proper storage temperature (4°C). Ice will be double bagged in ziplock baggies to prevent melt water from leaking into the shipping container. The ice chest will then be packed with vermiculite or other absorbent material to reduce the chance of breakage and absorb liquid should breaking occur. The original and yellow copies of the chain of custody

Table 5-4

Summary of Water Sampling and Analysis Requirements

Reference Method	Parameter	Container Type, No., and Volume [a]	Preservation and Storage Requirements	Maximum Holding Time (Preparation)	Maximum Holding Time (Analysis)
SW-846:6010	Al,Ba,Be,Ca,Cr,Co, Cu,Fe,Mg,Mn,Ni, K,Ag,Na,V,Zn	(1) 500 mL polyethylene bottle [a]	pH<2 w/HNO_3	N/S	6 months
SW-846:7041	Sb	(1) 500 mL polyethylene bottle	pH<2 w/HNO_3	N/S	6 months
SW-846:7060	As	(1) 500 mL polyethylene bottle [a]	pH<2 w/HNO_3	N/S	6 months
SW-846:7131	Cd	(1) 500 mL polyethylene bottle [a]	pH<2 w/HNO_3	N/S	6 months
SW-846:7421	Pb	(1) 500 mL polyethylene bottle [a]	pH<2 w/HNO_3	N/S	6 months
SW-846:7470	Hg	(1) 500 mL polyethylene bottle [a]	pH<2 w/HNO_3	N/S	28 days
SW-846:7740	Se	(1) 500 mL polyethylene bottle [a]	pH<2 w/HNO_3	N/S	6 months
SW-846:7841	Tl	(1) 500 mL polyethylene bottle [a]	pH<2 w/HNO_3	N/S	6 months
SW-846:8010	Vinyl Chloride	(2) 40 mL VOA vials	Refrigerated at 4 °C	N/A	14 days
SW-846:8240	Volatile Organics	(2) 40 mL VOA vials	Refrigerated at 4 °C, pH<2 w/HCl	N/A	14 days
SW-846:8270	Semivolatile Organics	(2) 1000 mL amber glass [b]; TFE-lined cap	Refrigerated at 4 °C	7 days	40 days
SW-846:8310	Polynuclear Aromatic Hydrocarbons	(2) 1000 mL amber glass [b]; TFE-lined cap	Refrigerated at 4 °C	7 days	40 days
SW-846:8040	Pentachlorophenol	(3) 1000 mL amber glass [b]; TFE-lined cap	Refrigerated at 4 °C	7 days	40 days
SW-846:8080	Organochlorine Pesticides/PCBs	(2) 1000 mL amber glass [b]; Teflon-lined cap	Refrigerated at 4 °C	7 days	40 days

Table 5-4

(Continued)

Reference Method	Parameter	Container Type, No., and Volume [a]	Preservation and Storage Requirements	Maximum Holding Time (Preparation)	Maximum Holding Time (Analysis)
EPA 310.1	Alkalinity	(1) 1000 mL amber glass	Refrigerated at 4 °C	N/A	28 days
EPA 300	Chloride	(1) 500 mL polyethylene	Refrigerated at 4 °C	N/A	14 days
EPA 340.2	Fluoride	(1) 500 mL polyethylene	Refrigerated at 4 °C	N/A	14 days
EPA 353.1	Nitrate/Nitrite	(1) 500 mL polyethylene	Refrigerated at 4 °C	N/A	14 days
EPA 300	Sulfate	(1) 500 mL polyethylene	Refrigerated at 4 °C	N/A	14 days
SW-846:9010	Cyanide	(1) 1000 mL amber glass	Refrigerated at 4 °C, NaOH to pH>12	14 days	48 hours

N/A = Not applicable
N/S = Not specified

[a] One 500 mL sample will provide sufficient sample volume for all metals analyses.

[b] Extra sample must be collected for matrix spike/matrix spike duplicate analysis.

Table 5-5

Summary of Soil and Sediment Sampling and Analysis Requirements

Reference Method	Parameter	Container Type, No., and Volume [a]	Preservation and Storage Requirements	Maximum Holding Time (Preparation)	Maximum Holding Time (Analysis)
SW-846:6010	Al,Ba,Be,Ca,Cr,Co, Cu,Fe,Mg,Mn,Ni,K ,Ag,Na,V,Zn	(1) 250 mL glass or polyethylene bottle [a]	Refrigerated at 4 °C	N/S	6 months
SW-846:7060	As	(1) 250 mL glass or polyethylene bottle [a]	Refrigerated at 4 °C	N/S	6 months
SW-846:7421	Pb	(1) 250 mL glass or polyethylene bottle [a]	Refrigerated at 4 °C	N/S	6 months
SW-846:7470	Hg	(1) 250 mL glass or polyethylene bottle [a]	Refrigerated at 4 °C	N/S	28 days
SW-846:7740	Se	(1) 250 mL glass or polyethylene bottle [a]	Refrigerated at 4 °C	N/S	6 months
SW-846:7841	Tl	(1) 250 mL glass or polyethylene bottle [a]	Refrigerated at 4 °C	N/S	6 months
SW-846:8240	Volatile Organics	(3) 40 mL VOA vials [b]	Refrigerated at 4 °C	N/A	14 days
SW-846:8270	Semivolatile Organics	(1) 250 mL amber glass; Teflon-lined cap [b]	Refrigerated at 4 °C	14 days	40 days
SW-846:8080	Pesticides/PCBs	(1) 250 mL amber glass; Teflon-lined cap [b]	Refrigerated at 4 °C	14 days	40 days
SW-846:9010	Cyanide	(1) 250 mL amber glass [b]	Refrigerated at 4 °C, NaOH to pH>12	N/A	14 days
SW-846:1311/ 6010 and 1311/7470	TCLP Metals	(1) 250 mL glass or polyethylene bottle	Refrigerated at 4 °C	14 days	180 days
SW-846:1311/ 8240	TCLP Volatiles	(3) 40 mL VOA vials	Refrigerated at 4 °C	14 days	14 days

N/A = Not applicable
N/S = Not specified

[a] One 250 mL sample will provide sufficient sample volume for all metals analyses.

[b] Extra sample is not required for matrix spike/matrix spike duplicate analysis.

form will be enclosed in a waterproof envelope or ziplock bag and placed in the shipping container. The shipping container and drain plug will be sealed and a custody seal (Figure 5-3) affixed to indicate possible tampering or accidental opening during shipment.

Shipping--A Federal Express airbill will be completed and addressed to the proper laboratory. Airbill charge numbers vary according to the location where the sample was taken and the type of sample. For the appropriate charge number, reference will be made to the project instructions. The pink copy will be retained and filed. The completed original airbill will be enclosed in a waterproof envelope or ziplock baggie and affixed to the shipping container. The sealed shipping container will then be taken to the air carrier's local office for overnight delivery to the analytical laboratory.

The shipping data will be entered into the sample master log, and the contracting laboratory will be informed of the incoming shipment (number of samples, types of requested analyses, and airbill number).

5.6 Calibration Procedures

Documented calibration procedures are required to provide consistency in preparing equipment for performing specific analytical measurements. Established calibration procedures provide a basis for comparing measurements taken with a specific type of instrument. Information for assigned laboratory equipment is presented in the method or laboratory SOP and will be summarized in this section. Calibration for non-assigned field equipment is also described below.

5.6.1 Field Calibration Procedures

Conductance - Modified EPA Method 120.1

The instrument will be calibrated prior to analysis of field samples with the appropriate standards. The calibration is checked at 5% frequency (minimum once per day) with a single point calibration standard. If the response varies less than ±10% of the calibration check sample, the calibration of the instrument is considered valid, and any meter drift is insignificant. A correction for temperature deviation from 25°C can be made using recorded field temperature values.

pH (Electrometric) - EPA Method 150.1

Each pH meter will be calibrated daily using a minimum of two standard buffer solutions. The adjusted readings must be within 0.05 pH units of each buffer solution value. The instrument will be calibrated prior to analysis of field samples with the appropriate standards. The calibration is checked at 5% frequency (minimum once per day) with a single point calibration standard. If the response varies less than ±10% of the calibration check sample, the calibration of the instrument is considered valid, and any meter drift is insignificant.

Temperature - EPA Method 170.1

Each thermometer should be routinely checked against a precision thermometer certified by the National Institute for Standards and Technology (NIST).

Organic Vapor Analyzer

Screening and survey analyses for total volatile organic compounds may be performed using portable organic vapor analyzers (OVAs), which feature hydrocarbon detection by flame ionization detection (FID). Factory calibrations will be conducted on a quarterly basis. A multipoint calibration check, including a zero and five concentration levels ranging from 10 to 10,000 or 100,000 ppmv (depending on the range of the instrument) will be performed monthly using methane in air. The data from these calibration checks will be maintained in the project file. Each standard will be composed of a certified mixture of methane in air and delivered via the normal sampling port at atmospheric pressure. Linearity of the calibration curves will be evaluated by linear regression analysis. A correlation coefficient (r) of ≥ 0.995 will be used as the acceptance criterion. If this criterion is not met, the calibration will be repeated (after instrument maintenance, if necessary) until r ≥ 0.995. Once linearity is considered acceptable, an average response factor (RF) will be calculated based on the multipoint data.

A calibration check will be performed daily prior to sampling. Response factors will be calculated daily and compared with control plots. The electronic calibration of the instrument will be checked and adjusted if necessary. Ultra high purity (UHP) air will then be analyzed to check the zero, then the mid- and high-level calibration standards will be analyzed using methane in air at concentrations of 100 and 10,000 ppmv. The response factors obtained for the calibration standards analyzed immediately before and after daily sampling must be within ±20% of the monthly multipoint response factor.

Photoionization Detector

Screening of the ambient air and head-space may be performed with a photoionization detector (PID). The PID is calibrated by service technicians prior to and following each field use. A multipoint calibration check, including a zero and at least three different concentrations of benzene in air, is performed by the technicians. Each standard will be delivered via the normal sampling port.

Field calibration will consist of standardizing the instrument to certified concentrations of benzene in air.

Field Gas Chromatograph

A PhotoVac Model 10S55 portable gas chromatograph (GC), or equivalent, will be used during the PA/SI field program to screen samples for laboratory analysis. The calibration procedures to be followed will depend on the type of instrument and methodology used. Typical calibration procedures for this type of instrument include gas standards containing target analytes which are representative of those expected in the samples. Known concentrations and quantities of a standard are analyzed and then the results, retention times, and detector responses for each standard are programmed into the GC.

5.6.2 Laboratory Calibration Procedures

Alkalinity - EPA Method 310.1

The pH meter is calibrated (± 0.05 pH units) daily by analyzing standard solutions. Also, the H_2SO_4 is standardized daily prior to sample analysis.

Chloride - EPA Method 325.2

A multipoint calibration curve (minimum of three points) is prepared daily by analyzing standard solutions. The curve is deemed acceptable if the correlation coefficient is greater than or equal to 0.995.

Cyanide - SW-846 Method 9012

A multipoint calibration curve (minimum of three points) is prepared daily by analyzing standard solutions. The curve is deemed acceptable of the correlation coefficient is greater than or equal to 0.995.

Fluoride - EPA Method 340.2

A calibration curve is generated using a matrix blank and five, or more, standard solutions ranging from zero to 2.0 mg/L fluoride. A calibration curve is deemed acceptable if the correlation coefficient is greater than or equal to 0.995.

Nitrate/Nitrite - EPA Method 353.1

A multipoint calibration curve (minimum of three points) is prepared daily by analyzing standard solutions of nitrate. The calibration curve is verified by analyzing a quality control sample. A calibration curve is deemed acceptable if the correlation coefficient is greater than or equal to 0.995 and recoveries for a QC check sample are within plus or minus ten percent.

Sulfate - EPA Method 300.0

A multipoint calibration curve (minimum of five points) is prepared daily by analyzing standard solutions containing sulfate. The calibration curve is verified by analyzing laboratory control samples. A calibration curve is deemed acceptable if the correlation coefficient is greater than, or equal to, 0.995 and recoveries for a QC check samples are in the range of 90 to 110 percent recovery.

Metals - SW-846 Method 6010

A mid-level mixed analyte calibration check solution is analyzed daily. Instrument calibration is deemed acceptable if agreement between the measured value and the expected value is within five percent.

Metals - Furnace Methods

A multipoint calibration curve is generated daily using a calibration blank and three upscale standards. The correlation coefficient for the linear regression equation must exceed 0.995 to be acceptable.

Mercury - SW-846 Method 7470/7471

A multipoint calibration curve is generated daily using a calibration blank and three upscale standards. The correlation coefficient for the linear regression equation must exceed 0.995 to be acceptable.

Halogenated Volatile Organics (GC/HECD) - SW-846 Method 8010

Instrument calibration involves a minimum of five concentration levels, prepared in reagent grade water from the secondary dilution of stock standards. The concentration of the lowest standard should be near, but above, the method detection limit (MDL). The correlation coefficient for each target parameter must be greater than or equal to 0.995.

Organochlorine Pesticides and PCBs - SW-846 Method 8080

Instrument calibration involves a minimum of five concentration levels. The concentration of the lowest standard should be near, but above, the method detection limit (MDL). The correlation coefficient for each target parameter must be greater than or equal to 0.995.

Pentachlorophenol - SW-846 Method 8040

Instrument calibration involves a minimum of five concentration levels. The concentration of the lowest standard should be near, but above, the method detection limit (MDL). The correlation coefficient for each target parameter must be greater than or equal to 0.995.

SW-846 Method 8240 - Volatile Organics

This method analyzes samples for volatile organics by scanning gas chromatography/mass spectrometry (GC/MS) following SW-846 Method 8240. The mass spectrometer will be tuned daily to give an acceptable spectrum for bromofluorobenzene (BFB). Relative ion abundance criteria for BFB are given in Table 5-3 for SW-846 Method 8240. The GC/MS operation must demonstrate that measured internal standards are not affected by method or matrix interferences. The base peak ion is used as the primary ion for quantitating the standards. If interferences are noted, the second most intense ion is used as the secondary ion. The internal standards added to all calibration standards and all sample extracts are analyzed by this method. Retention time standards, column performance standards, and a mass spectrometer tuning standard may be included in the internal standard solution.

The set of three internal standards--bromochloromethane, 1,4-difluorobenzene, and chlorobenzene-d_5, permit all sample chromatogram components of interest to have relative retention times (RRTs). The retention time standards show analytical behavior similar to the compounds of interest, and the standards show that their measurements are not affected by method or matrix interferences.

The GC/MS system used for these analyses is initially calibrated using the multipoint calibration technique. This calibration is described in the method. The multipoint calibrations involve deriving calibration curves based on five upscale concentrations, plus a zero point. One of the concentrations should be near, but just above, the IDL. The remaining concentrations should correspond to the expected range of concentrations found in the samples, or define the working range of the GC/MS system.

Linearity of the calibration curves is evaluated by using CCCs. The RSD must meet method criteria over the working range of the curve. The maximum percent RSD allowed for a CCC is 25%. The CCCs include the following: 1,1-dichloroethene, chloroform, 1,2-dichloropropane, toluene, ethylbenzene, and vinyl chloride. If these criteria are not met, the calibration is repeated (after instrument maintenance, if necessary) until CCC criteria are satisfied. Once the linearity is acceptable, an average RF is calculated based on the multipoint data.

Response factors must be verified every 12 hours. The concentrations selected should be near the midpoint of the working range. The RFs obtained for calibration standards analyzed before and after a set of samples must be within plus or minus 25% of the RF used to quantitate the sample concentrations.

Additional compounds are used to verify instrument sensitivity. These SPCCs are chloromethane, 1,1-dichloroethane, bromoform, 1,1,2,2-tetrachloroethane, and chlorobenzene. The minimum average response factor is 0.3 (0.25 for bromoform) for the system performance check compounds.

SW-846 Method 8270 - Semi-Volatile Extractable Organics

This method analyzes samples for semi-volatile extractable organics. Characteristic primary ion charge units are listed in the method. The GC/MS system is tuned daily by using decafluorotriphenylphosphine (DFTPP), and then calibrated using an internal standard calibration procedure. The GC/MS operation must demonstrate that measured internal standards are not affected by method or matrix interferences. The base peak ion is used as the primary ion for quantitating the standards. If interferences are noted, the second most intense ion is used as the secondary ion. The internal standards added to all calibration standards and all sample extracts are analyzed by this method. Retention time standards, column performance standards, and a mass spectrometer tuning standard may be included in the internal standard solution.

The set of six internal standards--d_4-1,4-dichlorobenzene, d_8-naphthalene, d_{10}-acenaphthene, d_{10}-phenanthrene, d_{12}-chrysene, and d_{12}-perylene--permit all sample chromatogram components of interest to have relative retention times (RRTs) within plus or minus 0.006 RRT units of its respective calibrated RRT. The retention time standards show analytical behavior similar to the compounds of interest, and the standards show that their measurements are not affected by method or matrix interferences.

The GC/MS system used for these analyses is initially calibrated using the multipoint calibration technique. This calibration is described in the method. The multipoint calibrations involve deriving calibration curves based on five upscale concentrations, plus a zero point. One of the concentrations should be near, but just above, the IDL. The remaining concentrations should correspond to the expected range of concentrations found in the samples, or define the working range of the GC/MS system.

Linearity of the six-point calibration curves is evaluated by using CCCs. The RSD must meet EPA criteria over the working range of the curve. The maximum percent RSD allowed for a CCC is 30%. The CCCs include the following: phenol, 1,4-dichlorobenzene, 2-nitrophenol, hexachlorobutadiene, 4-chloro3-methylphenol, 2,4,6-trichlorophenol, acenaphthene, n-nitrosodiphenylamine, pentachlorophenol, fluoranthene, di-n-octylphthalate, and benzo(a)pyrene. If these criteria are not met, the calibration is repeated (after instrument maintenance, if necessary) until CCC criteria are satisfied. Once the linearity is acceptable, an average RF is calculated based on the multipoint data.

Response factors must be verified every 12 hours. The concentrations selected should be near the midpoint of the working range. The RFs obtained for calibration standards analyzed before and after a set of samples must be within plus or minus 25% of the RF used to quantitate the sample concentrations.

Additional compounds are used to verify instrument sensitivity. These SPCCs are N-nitroso-di-n-propylamine and hexachlorocyclobenzidine. The minimum allowable SPCC RF versus internal standard RF ratio is 0.050 for both the initial calibration (as an average RF) and the single-point continuing calibration check.

Polynuclear Aromatic Hydrocarbons - SW-846 Method 8310

Instrument calibration involves a minimum of five concentration levels. The concentration of the lowest standard should be near, but above, the method detection limit (MDL). The correlation coefficient for each target parameter must be greater than or equal to 0.995.

5.7 Analytical Procedures

Several types of samples will be collected during the Wendover AFAF PA/SI, including groundwater, soils and possibly surface water. The majority of the chemical analyses will be performed according to procedures in SW-846, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, U.S. EPA, Office of Solid Waste and Emergency Response, November 1986, third edition and EPA Publication No. 600/4-79-020, "Methods for Chemical Analysis of Water and Wastes," March 1983. These methods and the method references are listed in Table 5-3. Information on maximum detection limits for specific analytes can be found in Table 5-3.

If methods other than those specified in these QA/QC protocols are to be used, the following procedure must be completed before making the change. A copy of the proposed method, including a table detailing the differences in the methods, the expected precision and accuracy, and an explanation for the change, must be submitted to the Radian

QA Coordinator. The QA Coordinator will review the request for change and will respond in writing as to whether the method may be substituted or not.

Descriptions of the extraction procedures, analytical methods, and physical tests to be used in the Wendover AFAF PA/SI work are presented in the following paragraphs.

5.7.1 Inorganic Analyses

Inorganic analyses required in the investigation of the Operable Unit 6 site include:

- Metals and anions;
- Specific conductance (field test);
- pH (field test); and
- Temperature (field test).

Procedures for each of these analyses are described in the following paragraphs.

Metals - SW-846 Method 6010, ICPES Procedures

Inductively Coupled Plasma Atomic Emission Spectroscopy (ICPES) determines elements in solution. All matrices, including groundwater and surface water, require digestion prior to analysis.

Elements for which SW-846 Method 6010 is applicable are listed in Table 5-2. The method describes a simultaneous or sequential multi-elemental determination by ICPES. Element-emitted light is measured by optical spectrometry. Samples are nebulized and the resulting aerosol is transported to the plasma torch. Element-specific atomic line emission spectra are produced by radio-frequency inductively coupled plasma. The spectra are dispersed and the lines monitored by photomultiplier tubes. Background must be measured and corrected for. Additional interferences are also possible and must be accounted for.

Metals - Furnace Methods

SW-846 Methods 7041, 7060, 7131, 7421, 7740, and 7841 are graphite furnace atomic absorption for determining the concentrations of antimony, arsenic, cadmium, lead, selenium, and thallium respectively. Following the appropriate method, a sample aliquot will be placed in a graphite tube in the furnace, evaporated, charred and atomized. Radiation from a given excited element is passed through the vapor containing ground-state atoms present. A monochromator isolates the characteristic radiation from the hollow cathode tube or electrodeless discharge lamp, and a photosensitive device measures the attenuated transmitted radiation.

Mercury - SW-846 Method 7470/7471

SW-846 Methods 7470 and 7471 both utilize a cold-vapor atomic absorption procedure for determining the concentrations of mercury. Following dissolution, mercury in the sample is reduced to the elemental state and aerated from solution in a closed system. The mercury vapor passes through a cell positioned in the light path of an atomic absorption spectrophotometer.

Nitrate/Nitrite EPA Method 353.1

In this method nitrate is reduced to nitrite with hydrazine sulfate. The nitrite concentration is determined by diazotizing with sulfanilamide and coupling with N-(1-naphthyl)-ethylenediamine dihydrochloride to form a highly colored azo dye which is measured colorimetrically.

Alkalinity EPA Method 310.1

In this method hydroxyl ions present in a sample are a result of dissociation or hydrolysis of solutes reacting with additions of standard acid. Alkalinity thus depends on the end-point pH used. The amount of acid required to reduce pH is measured carefully and a simple extrapolation can be made to the equivalence point.

Chloride EPA Method 325.2

In this method thiocyanate ion (SCN) is liberated from mercuric thiocyanate through sequestration of mercury by chloride ions to form un-ionized mercuric chloride. In the presence of ferric ion, the liberated SCN forms highly colored ferric thiocyanate in concentrations proportional to the original chloride concentration.

Cyanide SW-846 Method 9012

In this method cyanide is converted to cyanogen chloride (CNCl) without hydrolyzing to the cyanate by reaction with Chloramine-T at a pH less than 8. After the reaction is complete, color is formed on the addition of pyridine-barbituric acid reagent. The cyanide ion concentration in the absorbing solution is then determined by uv colorimetry.

Fluoride EPA Method 340.2

In this method the fluoride present in a water sample is determined potentiometrically using a fluoride electrode in conjunction with a standard single junction sleeve-type reference electrode, and a pH meter with an expanded millivolt scale or a selective ion meter with a direct concentration scale for fluoride.

Sulfate EPA Method 300.0

In this method a small volume of sample is introduced into an ion chromatograph. The sulfate ions are separated and measured using a system comprised of a guard column, separator column, suppressor column, and conductivity detector.

5.7.2 Organic Analyses

Organic analyses required in the investigation of Wendover AFAF include gas chromatography (GC) and gas chromatography/mass spectroscopy (GC/MS). Volatile organics will be analyzed using the method described below.

SW-846 Method 8010 - Halogenated Volatile Organics (GC/HECD)

Vinyl chloride concentrations in groundwater samples will be determined using SW-846 Method 8010. Also, groundwater samples collected with the HydroPunch® sampler will undergo analysis by Method 8010. This is a packed column gas chromatographic method. Samples are first processed using the purge and trap method. Separation for target species is accomplished by operating the GC in temperature-programmed mode. Detection is achieved using a halogen-specific detector, such as the Hall Electrolytic Conductivity Detector (HECD). Analysis on a second column will be performed to confirm analyte detection.

SW-846 Method 8040 - Pentachlorophenol

This method will be used to determine pentachlorophenol concentrations in water samples. SW-846 Method 8040 is a gas chromatographic method using a flame ionization detector (FID). Prior to analysis, the samples are extracted at a neutral pH using methylene chloride as a solvent.

SW-846 Method 8080 - Organochlorine Pesticides and PCBs

This method will be used to determine organochlorine pesticide and PCB concentrations in water and soil samples. SW-846 Method 8080 is a gas chromatographic method using electron capture detection or halide-specific detection. Prior to analysis, the samples are extracted at a neutral pH using methylene chloride as a solvent. The method is used to determine the concentration of certain organochlorine pesticides and polychlorinated biphenyls with second column confirmation.

SW-846 Method 8240 - Volatile Organics by GC/MS Analysis

The presence and concentration of purgeable halocarbon and organic compounds (volatile organics) in samples will be determined by Method 8240, a purge and trap gas chromatographic/mass spectrometer (GC/MS) technique. An inert gas is bubbled through the sample aliquot, to transfer the purgeable organic compounds from the liquid to the vapor phase. The vapor is then swept through a sorbent trap where the purgeables are trapped. The trap is backflushed and heated to desorb the purgeable organics onto a gas chromatographic capillary column where they are separated and then detected with a mass spectrometer.

SW-846 Method 8270 - Base/Neutrals and Acids by GC/MS Analysis

This method will be used to determine semi-volatile extractable organic compound concentrations in samples using a capillary column GC/MS procedure. The method applies to nearly all types of sample matrices regardless of water content, including ground and surface waters. The method is used to quantify most neutral, acidic, and basic organic compounds that are soluble in methylene chloride and capable of being eluted without derivatization as sharp peaks from a GC-fused silica capillary column coated with a slightly polar silicon. Compounds include polyaromatic hydrocarbons (PAHs), chlorinated hydrocarbons and pesticides, phthalate esters, organophosphate esters, nitrosamines, haloethers, aldehydes, esters, ketones, anilines, pyridines, quinolines, aromatic nitro compounds, and phenols, including nitrophenols. Prior to using this method, samples must be prepared for chromatography using the appropriate sample extraction method.

SW-846 Method 8310 - Polynuclear Aromatic Hydrocarbons

SW-846 Method 8310 will be used to determine the concentration of polynuclear aromatic hydorcarbons (PAHs) in water samples. This method provides high performance liquid chromatographic (HPLC) conditions for the detection of parts per billion levels of PAHs by ultraviolet (uv) and fluorescence detectors.

5.7.3 Toxic Characteristic Leaching Procedure (TCLP)

SW-846 Method 1311

Solid samples selected for TCLP analysis will be prepared in accordance with SW-846 Method 1311. The TCLP leachate will be analyzed for heavy metals and the TCLP volatile organic list. The heavy metals analyzed will be arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver.

5.7.4 General Parameters

Conductance EPA Method 120.1

The specific conductance of a sample will be measured using a self-contained conductivity meter. Samples will be analyzed at ambient temperature. Temperature will also be recorded at the time of analysis.

pH - EPA Method 150.1

The pH of water samples will be measured in the field potentiometrically (EPA Method 150.1) using a standard pH meter. The pH meter will be calibrated daily at two points using buffered standards.

Temperature - EPA Method 170.1

Temperature will be measured for selected water samples according to EPA Method 170.1 using a factory calibrated, mercury filled thermometer.

5.7.5 Geotechnical Analyses

The following geotechnical analyses will be performed on selected soil samples obtained during the Wendover AFAF PA/SI:

- ASTM Method D2216 - Soil Moisture
- ASTM Method 4318 - Atterburg Limits
- ASTM Method D422 - Sieve Analysis
- ASTM Method D5084 - Permeability (Saturated Tri-Axl)
- ASTM Method D2974 - Organic Content
- SW-846:9080/9081 - Cation Exchange Capacity
- SW-846:9100 - Vertical Hydraulic Conductivity

5.8 Data Reduction, Validation, and Reporting

Figure 5-5 presents the overall data reduction, validation, review, and reporting flow scheme for this project. Samples will be analyzed within required holding times. If holding times are exceeded, the PD will be notified, and, if necessary, additional samples will be collected and analyzed. In most cases, calculations from raw data are

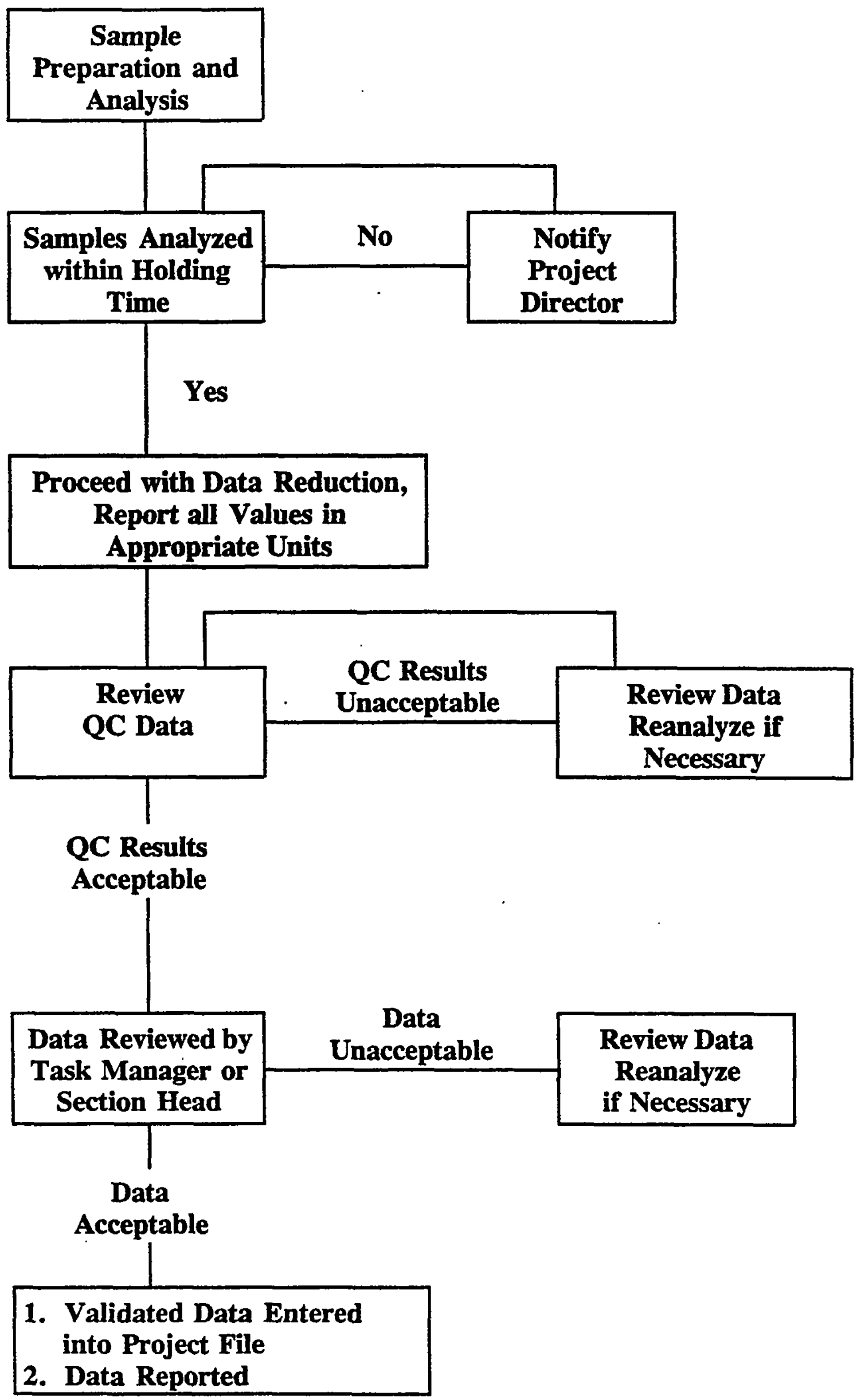


Figure 5-5. Data Reporting Scheme

included in discussions of analytical procedures presented in the EPA and SW-846 methods. These data reduction and validation procedures will not be repeated here. Details of data reduction, validation, and reporting not addressed elsewhere are discussed in this section.

5.8.1 Data Reduction

Data reduction calculations used for this program are typically included on the standard reporting forms associated with each method. Calculations not covered on the standard reporting forms include computer-based data reduction programs. Each laboratory is responsible for maintaining a listing of these data reduction programs and for demonstrating their validity if necessary. The complete calculation procedures used in computer-based data reduction programs are based on the calculation procedures specified in each method and will not be covered here.

Database review will always be conducted by a person other than whom entered the data originally. Changes to the original data will be made on copies indicating the nature of the change, reason for the change, and person requesting the change. This information will be filed with the original documents. Data management personnel will receive copies of the changes and make the appropriate changes to the database. Additional validation will be performed by the Supervising Geologist reviewing copies of the original documents and through various applications (reports, maps, etc.) of the database. Errors will be documented and reported to data management personnel for correction.

5.8.2 Data Quality Review

The QA Coordinator will review all measurement data for adherence to prescribed QC procedures. Any suspect data will be flagged in the report and identified with respect to the nature of the validity problem. Data quality, in terms of completeness, will be discussed in the final report.

Several of the data validation acceptance criteria involve specific calculations. Example calculations are presented below.

Instrument Response Linearity (Calibration)

Acceptance criteria for instrument response linearity checks are based upon the correlation coefficient, r, of the best fit line for the calibration data points. The correlation coefficient reflects the linearity of response to the calibration standards and is calculated as:

$$r = \frac{n\sum(xy) - (\sum x)(\sum y)}{\sqrt{[n(\sum x^2) - (\sum x)^2][n(\sum y^2) - (\sum y)^2]}}$$

where: x = calibration concentrations;

y = instrument response (peak area); and

n = number of calibration points (x,y data pairs).

Precision

Control limits for control sample analyses, acceptability limits for replicate analyses, and response factor agreement criteria specified for calibration and internal QC checks are based upon precision, in terms of the coefficient of variation (CV) or the relative percent difference (RPD). The standard deviation of a sample set is calculated as:

$$S = \text{standard deviation} = \sqrt{\frac{\sum (x-\bar{x})^2}{(n-1)}}$$

where: x = individual measurement;

$\bar{x}$ = mean value for the individual measurements; and

n = number of measurements.

The CV is then calculated as:

$$CV = \left(\frac{S}{\bar{x}}\right) \times 100\%$$

The relative percent difference (RPD) calculation allows for the comparison of two analysis values in terms of precision with no estimate of accuracy. Relative percent difference is calculated as:

$$RPD = \frac{|M - m|}{\left(\frac{M + m}{2}\right)} \times 100\%$$

where: M = first measurement value; and
m = second measurement value.

For duplicate measurements, CV is related to RPD by the following:

$$CV = \frac{RPD}{\sqrt{2}}$$

and

$$\text{Pooled CV} = \sqrt{\frac{\sum RPD^2}{2k}}$$

where: k = number of duplicate pairs.

Accuracy

The accuracy of data is typically summarized in terms of relative error (RE). This calculation reflects the degree to which the measured value agrees with the actual value, in terms of percent of the actual value. Relative error is calculated as:

$$\% \text{ Relative Error} = \frac{\text{Measured Value} - \text{Actual Value}}{\text{Actual Value}} \times 100$$

This way of expressing accuracy allows for a comparison of accuracy at different levels (e.g., different concentrations), and for different parameters of the same type (e.g., different compounds analyzed by the same method). Control sample analyses are typically evaluated using this calculation. Relative error (RE) and relative percent difference (RPD) appear very similar at a glance, but they are not the same and should not be confused. The information that each calculation conveys is very specific about the data being compared.

$$\text{Relative Percent Difference} = \frac{\text{Measured Value 1} - \text{Measured Value 2}}{\text{Mean Value}} \times 100$$

In this program, another calculation is frequently used to assess the accuracy of a procedure. Percent recovery is a calculation used to determine the performance of many of the quality control checks. Percent recovery is calculated as:

$$\% \text{ Recovery} = \frac{\text{Measured Value}}{\text{Actual Value}} \times 100$$

Another similar calculation used to determine the performance of a method for recovery of a spike concentration added to a sample is the percent spike recovery calculation. The percent spike recovery is determined as:

$$\%\ \text{Spike Recovery} = \frac{(\text{Value of Sample Plus Spike}) - (\text{Value of Unspiked Sample})}{(\text{Value of Spike Added})} \times 100$$

5.8.3 Reporting

The Project Director will coordinate the preparation of all formal reports for this program with input from the Supervising Geologist, QA Coordinator, and other project team members. Data packages for each media sampled (i.e., groundwater, soils) will be validated by the QA Coordinator and forwarded to the Wendover AFAF Project Manager within 50 days of sample collection. Also, the RI report will include a summary and discussion of the results of QC procedures and QA activities by the QA Coordinator performed as part of the investigation.

5.9 Internal Quality Control

An internal quality control system is a set of routine internal procedures for assuring that the data output of a measurement system meets prescribed criteria for data quality. Inherent and implied in this control function is a parallel function of measuring and defining the quality of the data output. A well-designed internal QC program must be capable of controlling and measuring the quality of the data, in terms of precision and accuracy. Precision reflects the influence of the inherent variability in sampling and measurement systems. Accuracy reflects the degree to which the measured value represents the actual or "true" value for a given parameter, and includes elements of both bias and precision. Accuracy of measurement data is related to the precision and bias of the component parts of the measurement system.

Generally, internal quality control procedures may be divided into two overlapping categories. One category includes those procedures which are used to control data quality within prescribed limits of acceptability. These acceptability limits are usually related to data precision, accuracy, and completeness. The other category includes those procedures designed to provide a quantitative assessment of data quality, again in terms of precision, accuracy, and completeness. Some internal QC procedures, by their nature, serve both control and assessment functions.

This section addresses QC procedures associated with the various sampling efforts and analytical methods. Included are general quality control considerations, as well as specific quality control checks which provide ongoing control and assessment of data quality, in terms of precision and accuracy. A summary of internal QC checks and calibration procedures for each analytical method is presented in Table 5-6.

QC standards will be prepared from stock standard solutions which are different than those from which the calibration standards are prepared. EPA QC Check Samples or other certified commercial solutions will be used. QC check standards will contain the analyte(s) of interest at concentrations in the mid-calibration range.

5.9.1 Analytical Quality Control

Gas Chromatography Quality Control

Analytical quality control procedures for GC analyses (SW-846 Methods 8010, 8040 and 8080) include the following:

- Initial demonstration of capability;
- Calibration verification;
- Analysis of Laboratory Control Samples;

Table 5-6

Summary of Internal Quality Control Procedures

Analytical Method	Parameter	Quality Control Check	Frequency[a]	Acceptance Criteria	Corrective Action
SW-846: 7041 7060 7130 7421 7841 7740	GFAA Antimony Arsenic Cadmium Lead Thallium Selenium	Laboratory Laboratory Control Sample (LCS)	1 per digestion batch ≤ 20 samples	Measured value ±15% of true value for element of interest	Repeat calibration
		LCS duplicate	1 per digestion batch ≤ 20 samples	RPD ≤ 20% and 75-125% recovery of true value	1) Reanalyze 2) Repeat calibration 3) Consult laboratory manager
		Method blank	1 per digestion batch ≤ 20 samples	< 5x Method detection limit	1) Reanalyze 2) Recalibrate 3) Reanalyze 4) Redigest samples if reanalysis fails
		Calibration blank	10%	< 5x Method detection limit	1) Reanalyze 2) Clean system 3) Reanalyze sample 4) Redigest samples if reanalysis fails
		Multipoint calibration	Initially and as required	r>0.995	Repeat calibration
		Matrix Spike	5%	75-125% of true value	1) Analyze method spike 2) If method is ok; flag data 3) If method is not ok; contact lab supervisor and reanalyze samples
		Matrix Spike Duplicate	5%	Relative percent difference ≤ 20% and 75-125% recovery of true value	1) Analyze method spike 2) If method spike is ok: flag data 3) If method spike is not ok: contact lab supervisor and reanalyze samples
		Field Duplicate field sample	5%, minimum one per program	None	Determine sampling/analytical variability
		Equipment blank	5%, minimum one per program	None	Used to determine sources of contamination
SW-846: 7470/7471	Mercury	Laboratory Laboratory Control Sample (LCS)	1 per digestion batch ≤ 20 samples	Measured value ±20% of true value for element of interest	Repeat calibration
		LCS duplicate	1 per digestion batch ≤ 20 samples	RPD ≤ 20% and 75-125% recovery of true value	1) Reanalyze 2) Repeat calibration 3) Consult laboratory manager
		Preparation blank	1 per digestion batch ≤ 20 samples	< 5x Method detection limit	1) Reanalyze 2) Recalibrate 3) Reanalyze samples 4) Redigest samples if reanalysis fails

Table 5-6
(Continued)

Analytical Method	Parameter	Quality Control Check	Frequency*	Acceptance Criteria	Corrective Action
SW-846: 7470/7471 (con't)	Mercury	Calibration blank	10%	< 5x Method detection limit	1) Reanalyze 2) Clean system 3) Reanalyze samples 4) Redigest samples if reanalysis fails
		Multipoint calibration	Initially and as required	r>0.995	Repeat calibration
		Matrix Spike	5%	75-125% of true value	1) Analyze method spike 2) If method spike is ok; flag data 3) If method spike is not ok; contact lab supervisor and reanalyze samples
		Matrix Spike Duplicate	5%	Relative percent difference ≤ 20% and 75-125% recovery of true value	1) Analyze method spike 2) If method spike is ok; flag data 3) If method spike is not ok; contact lab supervisor and reanalyze samples
		~~Field~~ Duplicate field sample	5%, minimum one per program	None	Determine sampling/analytical variability
		Equipment blank	5%, minimum one per program	None	Used to determine sources of contamination
SW-846:9012	Cyanide	~~Laboratory~~ Calibration Blank	10%	< 5x Reporting Detection Limit (RDL)	1) Reanalyze 2) Clean system 3) Reanalyze sample
		Multipoint calibration	Daily, prior to sample analysis and as required	r ≥0.995	Repeat Calibration
		Method blank	1 per batch ≤20 samples	<0.02 µg/L	1) Clean instrument/equipment 2) Reanalyze
		Laboratory Control Sample (LCS)	10%	75-125% of true value	1) Reanalyze 2) Repeat Calibration 3) Consult laboratory manager
		LCS Duplicate	10%	Relative Percent Difference ≤20% and 75-125% of true value	1) Reanalyze 2) Repeat calibration 3) Consult laboratory manager
		Matrix spike	5%	75-125% of true value	1) Reanalyze 2) If method spike is okay; flag data 3) If method spike is not okay; contact laboratory manager and reanalyze samples
		Matrix spike duplicate	5%	Relative Percent Difference ≤20% and 75-125% recovery of true value	

Table 5-6
(Continued)

Analytical Method	Parameter	Quality Control Check	Frequency[a]	Acceptance Criteria	Corrective Action
SW-846:9012 (con't)	Cyanide	Field Duplicate Field Sample	5%, minimum one per program	None	Used to assess sampling/analytical variability
		Equipment Blank	5%, minimum one per program		Used to assess sources of contamination
		Laboratory Duplicate Analysis	5%	± 10%	Repeat sample analyses
		Field Equipment Blank	5%, or 1 per sampling event	None	Will be used to determine sources of contamination
SW-846:6010	Metals (ICPES)	Laboratory Control Sample (LCS)	1 per digestion batch ≥20 samples	Measured value within ±10% of true value for element of interest	Repeat calibration
		Preparation blank	1 per digestion batch ≥20 samples	<5 x Method detection limit	1) Reanalyze 2) Recalibrate 3) Reanalyze 4) Redigest samples if reanalysis fails
		Calibration blank	10%	<5 x Method detection limit	1) Rerun 2) Clean system 3) Reanalyze sample 4) Redigest samples if reanalysis fails
		Calibration check	10%	Measured value within ±10% of true value for element of interest	Repeat calibration
		Matrix spike analysis	5%	75-125% of true value	1) Analyze method spike (or LCS) 2) If method spike is ok; flag data 3) If method spike not ok; see lab supervisor and reanalyze samples
		Matrix spike duplicate	5%	Relative percent difference ≤20% and 75-125% of true value	1) Analyze method spike (or LCS) 2) If method spike is ok; flag data 3) If method spike not ok; see lab supervisor and reanalyze samples
		ICP interference check	Run at beginning and end of daily run	80-120% of true value for EPA check sample elements	1) Repeat calibration 2) See lab manager
		ICP linear range check	Quarterly	Measured value within ±5% of expected value	Tests upper limit of ICP linear range
		Instrument detection limit	Quarterly	<MDL	Used to verify current IDL
		Field Duplicate field sample	5%, minimum one per program	None	Determine sampling/analytical variability

Table 5-6
(Continued)

Analytical Method	Parameter	Quality Control Check	Frequency[a]	Acceptance Criteria	Corrective Action
SW846:6010 (con't)	Metals (ICPES)	Equipment blanks	5%, minimum one per program	None	Used to determine sources of contamination
SW-846:8270	Semivolatile Organic Compounds	Laboratory Check of mass spectral ion intensities using DFTPP	Daily prior to sample analysis	Refer to method	Retune instrument Repeat DFTPP analysis
		5-point calibration at 10-200 ppb range	Initial calibration	RF variability for specific compounds <30% RSD	Repeat calibration
		System performance check	Every 12 hours	Minimum average response factor of 0.050	1) Evaluate system 2) Repeat calibration
		Continuing calibration check compounds (CCC)	Every 12 hours	Single-point RF for each CCC within 30% of average multi-point RF	1) Evaluate system 2) Take corrective action 3) Repeat test 4) See lab manager
		Surrogate spikes	Every sample	Based on method (Table 8)	1) Evaluate system 2) Recalculate data and/or reanalyze extract 3) Analyze LCS, if LCS fails, reextract and reanalyze samples 4) Flag data and report analysis and reanalysis results
		Laboratory Control Sample LCS	5%	Refer to method (Table 6)	1) Evaluate system 2) Repeat analysis for criteria that failed
		LCS Duplicate	5%	≤50% RPD and recovery within limits of method (Table 6)	1) Evaluate system 2) Repeat analysis for criteria that failed
		Internal standards	Every sample	Refer to method (Table 5)	1) Inspect mass spectrometer 2) Correct problems and repeat calibration 3) Reanalyze samples
		Extraction blank	Daily prior to sample analysis	<DL except for phthalate esters which may be 5 x DL	1) Run solvent blank 2) Evaluate system
		Matrix spike	5%	Refer to method (Table 6)	1) Run check sample (LCS) 2) Correct problem 3) If LCS fails, reanalyze samples 4) Flag data
		Matrix spike duplicate	5%	≤50% RPD and recovery within limits of method (Table 6)	1) Run check samples (LCS) 2) Correct problem 3) If LCS fails, reanalyze samples 4) Flag data

Table 5-6
(Continued)

Analytical Method	Parameter	Quality Control Check	Frequency[a]	Acceptance Criteria	Corrective Action
SW-846:8240	Volatile Organic Compounds	Field Equipment blank	5%	None	Will be used to determine sources of contamination
		Duplicate field sample	5%	None	Will be used to determine analytical variability
		Laboratory Check of mass spectral ion intensities using BFB	Daily prior to sample analysis	Refer to method (Table 3)	1) Retune instrument 2) Repeat BFB analysis
		5-point calibration at 10-200 ppb range	Initial calibration; and as required	RF variability for specific compounds <25% RSD	Repeat calibration
		System performance check	Every 12 hours	RF ≥0.300 (0.250 for bromoform)	1) Evaluate system 2) Repeat calibration
		Calibration check compounds	Every 12 hours	% Difference <30%	1) Evaluate system 2) Repeat test 3) Recalibrate
		Surrogate spikes	Every sample	Based on method (Table 8)	1) Evaluate system 2) Recalculate data and/or reanalyze extract 3) Reanalyze sample 4) Flag data and report analysis and reanalysis results
		Laboratory Control Sample (LCS)	5%	Refer to method (Table 6)	1) Evaluate system 2) Repeat analysis for criteria that failed
		LCS duplicate	5%	≤ 50% RPD and recovery within limits of method (Table 6)	1) Evaluate system 2) Repeat analysis for criteria that failed
		Internal standards	Every sample	Refer to method (Table 5)	1) Inspect mass spectrometer 2) Correct problem 3) Repeat calibration 4) Reanalyze samples
		Laboratory Control Sample (LCS)	5%	Refer to method (Table 5)	1) Evaluate system 2) Repeat analysis for criteria that failed
		LCS duplicate	5%	≤ 50% RPD and recovery within limits of method (Table 5)	1) Evaluate system 2) Repeat analysis for criteria that failed
		Matrix spike	5%	Refer to method (Table 6)	1) Run check samples (LCS) 2) Correct problem 3) If LCS is ok; flag data 4) If LCS is not ok; reanalyze samples

Table 5-6
(Continued)

Analytical Method	Parameter	Quality Control Check	Frequency*	Acceptance Criteria	Corrective Action
SW-846:8240 (con't)	Volatile Organic Compounds	Matrix spike duplicate	5%	≤50% RPD and recovery within limits of method (Table 6)	1) Run check sample (LCS) 2) Correct problem 3) If LCS is ok; flag data 4) If LCS is not ok; reanalyze samples
		Field Duplicate field samples	5%	None	Used to determine sampling/analytical variability
		Equipment blank	10%; or one per sampling event	None	Will be used to determine sources of contamination
		Trip blank	5%; or one per sampling event	None	Will be used to determine sources of contamination
SW-846:8310	Polynuclear Aromatic Hydrocarbons	Laboratory Multipoint calibration (minimum five points)	Initially, as required	r ≤0.995 or RSD <<20%	Repeat calibration
		Calibration check sample	*Daily prior to sample analyses*	RPD <15%	*Repeat 5-point calibration*
		Surrogate spikes	Every sample	Based on method (Table 3)	1) Evaluate system 2) Recalculate data and/or reanalyze extract 3) Analyze LCS, if LCS fails reextract and reanalyze sample 4) Flag data and report analysis and reanalysis results
		Method blank	5%	<5x RDL	1) Reanalyze 2) Clean system 3) Reanalyze samples
		Laboratory Control Sample (LCS)	5%	Refer to method (Table 3)	1) Evaluate system 2) Repeat analysis for criteria that failed
		LCS Duplicate	5%	RPD <50% and recovery within method specified limits (Table 3)	1) Evaluate system 2) Repeat analysis for criteria that failed
		Matrix spike	5%	Refer to method (Table 3)	1) Analyze LCS 2) Correct problem
		Matrix spike duplicate	5%	RPD <50% and recovery within method specified limits (Table 3)	1) Analyze LCS 2) Correct problem 3) If LCS is okay; flag data 4) If LCS is not okay; reanalyze samples
		Field Duplicate field sample	5%, minimum one per program	None	Used to assess variability

Table 5-6
(Continued)

Analytical Method	Parameter	Quality Control Check	Frequency[a]	Acceptance Criteria	Corrective Action
SW-846:8310 (con't)	Polynuclear Aromatic Hydrocarbons (con't)	Equipment blanks	5%, minimum one per program	None	Used to assess sources of contamination
SW-846:8040	Phenols (Pentachlorophenol)	~~Laboratory~~ Multipoint calibration (minimum five points)	Initially, as required	r ≥0.995 or RSD <20%	Repeat calibration
		Calibration check sample	Daily prior to sample analyses	RPD <15%	Repeat 5-point calibration
		Surrogates	Every sample	Based on method	1) Evaluate system 2) Recalculate data and/or reanalyze extract 3) Analyze LCS, if LCS fails reextract and reanalyze sample 4) Flag data and report analysis and reanalysis results
		Method blank	5%	<5x RDL	1) Reanalyze 2) Clean system 3) Reanalyze samples
		Laboratory Control Sample (LCS)	5%	Refer to method (Table 4)	1) Evaluate system 2) Repeat test for criteria that failed
		LCS duplicate	5%	RPD <50% and recovery within method specified limits (Table 3)	1) Evaluate system 2) Repeat test for criteria that failed
		Matrix spike	5%	Refer to method (Table 3)	1) Analyze LCS 2) Correct problem 3) If LCS is okay; flag data 4) If LCS is not okay; reanalyze samples
		Matrix spike duplicate	5%	RPD <50% and recovery within method specified limits (Table 3)	1) Analyze LCS duplicate 2) Correct problem 3) If LCS is okay; flag data 4) If LCS is not okay; reanalyze samples
		Field ~~Duplicate~~ field sample	5%	None	Used to assess variability
		Equipment blank	5%	None	Used to assess contamination
SW-846:8010	Halogenated Volatile Hydrocarbons (Vinyl chloride)	~~Laboratory~~ Multipoint calibration (minimum five points)	Initially, as required	r ≥0.995 or RSD <20%	Repeat Calibration
		Calibration check sample	Daily, prior to sample analyses	RPD <15%	Repeat 5-point calibration

Table 5-6
(Continued)

Analytical Method	Parameter	Quality Control Check	Frequency*	Acceptance Criteria	Corrective Action
		Surrogate	Every sample	Based on method	1) Evaluate system 2) Recalculate data and/or reanalyze sample
		Method blank	5%	<5x RDL	1) Reanalyze 2) Clean system 3) Reanalyze sample
		Laboratory Control Sample (LCS)	5%	Refer to method (Table 3)	1) Evaluate system 2) Repeat test for criteria that failed
		LCS duplicate	5%	RPD <50% and recovery within method specified limits (Table 3)	1) Evaluate system 2) Repeat test for criteria that failed
		Matrix spike	5%	Refer to method (Table 3)	1) Analyze LCS 2) Correct problem 3) If LCS is okay; flag data 4) If LCS is not okay; reanalyze samples
		Matrix spike duplicate	5%	RPD <50% and recovery within method specified limits (Table 3)	1) Analyze LCS duplicate 2) Correct problem 3) If LCS duplicate is okay; flag data 4) If LCS duplicate is not okay; reanalyze samples
		Field Duplicate field sample	*5%, minimum one per program*	None	*Used to determine sources of variability*
		Equipment blank	5%, minimum one per program	None	Used to assess sources of contamination
		Trip blank	5%, minimum one per program	None	Used to assess sources of contamination
SW-846:8080	Organochlorine Pesticides and PCBs	Laboratory Multipoint calibration (minimum five points)	Initially, as required	RSD <20%	Repeat calibration
		Calibration check sample	Daily prior to sample analyses	RPD <15%	Repeat 5-point calibration
		DDT and endrin degradation check sample	*Daily prior to analyses*	*Degradation ≤20% (see method)*	*1) Follow maintenance in Method 8000, see Section 7.7* 2) Recalibrate
SW-846:8080 (con't)	Organochlorine Pesticides and PCBs	Surrogate spikes	Every sample	Based on method	1) Evaluate system 2) Recalculate data and/or reanalyze extract 3) Analyze QCCS, if QCCS fails reextract and reanalyze sample 4) Flag data and report analysis and reanalysis results

Table 5-6
(Continued)

Analytical Method	Parameter	Quality Control Check	Frequency*	Acceptance Criteria	Corrective Action
		Method blank	5%	None	Used to assess contamination
		Laboratory Control Sample (LCS)	5%	Refer to method (Table 3)	1) Evaluate system 2) Repeat test for criteria that failed
		LCS duplicate	5%	RPD < 50% and recovery within method recovery limits (Table 3)	1) Evaluate system 2) Repeat test for criteria that failed
		Matrix spike	5%	Refer to method (Table 3)	1) Analyze QCCS 2) Correct problem 3) If QCCS is ok; flag data 4) If QCCS is not ok; reanalyze samples
		Matrix spike duplicate	5%	RPD <50% and recovery within method specified limits (Table 3)	1) Analyze QCCS 2) Correct problem 3) If QCCS is ok; flag data 4) If QCCS is not ok; reanalyze samples
		Field Duplicate field samples	5%; minimum one per program	None	Will be used to determine analytical variability
		Equipment blanks	5%; minimum one per program	None	Used assess sources of contamination

* Frequencies for duplicate samples and field blanks are computed based on the total number of samples taken for and the number of analyses specified in the SOW.

LCS = Laboratory Control Sample
MDL = Method Detection Limit
MS = Matrix Spike
MSD = Matrix Spike Duplicate
N/A = Not Applicable
RF = Response Factor
RDL = Reporting Detection Limit
RPD = Relative Percent Difference

- Analysis of surrogate spiked samples;
- Method blank analyses;
- Analysis of matrix spike/matrix spike duplicates; and
- Retention time window checks.

These procedures are described below.

Initial Demonstration of Capability--Before analyzing samples by a GC method, the laboratory must demonstrate the ability to generate acceptable accuracy and precision. This is done by analyzing four aliquots of a Laboratory Control Samples (LCS) by the same procedure used to analyze samples. The laboratory should calculate the average recovery and the standard deviation of the recovery for each analyte of interest using the four results. The mean recovery and standard deviation for each analyte should be compared with the corresponding acceptance criteria published in the reference method. If the experimental accuracy and precision data are acceptable, analyses may proceed; if not, remedial action must be taken to improve system performance.

Calibration Verification--Instrument tuning and calibration procedures are described in Section 5.7.

Laboratory Control Sample Analyses--Laboratory Control Samples (LCS) may be obtained from EPA or prepared from suitable reference materials, but must be prepared independently of calibration standards. The LCS should contain the analyte(s) of interest at concentrations in the mid-calibration range. Measured values should be plotted on a QC control chart. A LCS must be analyzed if matrix spike recoveries are unacceptable to verify that the analytical system is in a state of control.

Surrogate Spikes--A surrogate standard is a chemically inert compound not expected to occur in an environmental sample. The use of surrogate compounds may be limited by the ability to select a suitable surrogate for a particular parameter class. If the surrogate spike recovery in any sample is outside method specification limits, the following corrective action will be followed:

- Check for errors in calculations, surrogate solutions and standards. Check instrument performance.
- Recalculate the data and/or reanalyze the extract if any of the above checks reveal a problem.
- Re-extract and reanalyze the sample if none of the above are a problem, or flag the data as "estimated concentration."

Method Blank Analyses--Before processing any samples, the analyst should demonstrate through the analysis of a reagent water method blank that all glassware and reagents are interference-free. Each time a set of samples is extracted or there is a change in reagents, a method blank should be processed as a safeguard against chronic laboratory contamination. The blank samples should be carried through all stages of the sample preparation and measurement steps.

Matrix Spike/Matrix Spike Duplicate--Matrix spike and matrix spike duplicate samples should be analyzed for each matrix type (5 percent minimum frequency). When matrix spike results fall outside the laboratory established limits, or outside limits published in the respective methods, a LCS must be analyzed to demonstrate analytical control. If spike recoveries are outside normal limits due to matrix problems, the data should be flagged.

Retention Time Windows--The laboratory will calculate retention time windows for each standard on each GC column and whenever a new GC column is installed. To establish windows, make three injections of all single component standard mixtures and multiresponse products (e.g., PCBs) throughout the course of a 72-hour period. Calculate the standard deviation of the three absolute retention times for each single component standard. For multiresponse products, choose one major peak from the envelope. If the standard deviation for a particular standard is zero, substitute the standard deviation of a close eluting, similar compound to develop a valid retention time window.

The laboratory will establish daily retention time windows for each analyte. Use the absolute retention time for each daily calibration standard as the midpoint of the window for that day. The daily retention time window equals the midpoint + three times the standard deviation determined above. All succeeding standards in an analysis sequence must fall within the daily retention time window established by the first standard of the sequence.

Mass Spectroscopy Quality Control

Analytical quality control procedures for GC/MS analyses (SW-846 Methods 8240 and 8270) are described in SW-846 Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, U.S. EPA, Office of Solid Waste and Emergency Response, November 1986, 3rd edition and include:

- Initial demonstration of capability;
- Calibration verification;
- Laboratory Control Sample analyses;
- Surrogate standard spike samples;
- Method blank analyses;
- Analysis of field blanks;
- Matrix spike duplicate analyses;
- Analysis of duplicate samples;

- Mass spectrometer sensitivity check; and
- Daily GC/MS performance tests.

Each of these is described below.

Initial Demonstration of Capability--Before analyzing samples by a method, the laboratory must demonstrate the ability to generate acceptable accuracy and precision. This is done by analyzing four aliquots of a Laboratory Control Sample. The laboratory should calculate the average recovery and the standard deviation of the recovery for each analyte of interest using the four results. The mean recovery and standard deviation for each analyte should be compared with the corresponding acceptance criteria published in the method. If the experimental accuracy and precision data are acceptable, analyses may proceed; if not, remedial action must be taken to improve system performance.

Calibration Verification--Instrument tuning and calibration procedures are described in Section 5.7.

Laboratory Control Sample Analyses--Laboratory Control Samples (LCS) may be obtained from EPA or prepared from suitable reference materials, but must be prepared independently of calibration standards. The LCS should contain the analyte(s) of interest at a concentration in the mid-calibration range. Measured values should be plotted on a QC control chart. A LCS must be analyzed is matrix spike recoveries are unacceptable to verify that the analytical system is in a state of control.

Surrogate Standard Spike Samples--All samples will be spiked with a surrogate standard as described in the method. If the surrogate spike recovery in any sample is not within limits, checks should be made for errors in calculations, surrogate solutions and standards and instrument performance checked. If any of the above checks reveal a problem, the data should be recalculated and/or the extract reanalyzed. If these fail to reveal a problem, the sample should be re-extracted and/or reanalyzed or the data flagged as "estimated." The laboratory must monitor the frequency of data so qualified to ensure that it remains at or below 5 percent. For SW-846 Method 8270, three base/neutral surrogate standards, nitrobenzene-d_5, 2-fluorobiphenyl, and p-terphenyl-d_{14}, and three acid surrogate standards, phenol-d_5, 2-fluorophenol, and 2,4,6-tribromophenol, are used to monitor recovery of semivolatile organics. For SW-846 Method 8240 three purgeable surrogate standards, 1,4-bromofluorobenzene, 1,2-dichloroethane-d4, and toluene-d8, are used to monitor recovery of volatile organics.

Method Blank Analyses--A method (reagent) blank should be analyzed every 12 hours to demonstrate that analytical system interferences are below acceptable limits. Surrogate recoveries for the blank must meet the requirements established in the method before analyses can continue.

Analysis of Field Blanks--Field blanks samples are collected during the sampling activities and analyzed to determine whether samples are being contaminated by sampling equipment and/or spurious contamination in the ambient air. Field blanks samples should be collected on a daily basis. Frequency of field blank collection is shown on Table 5-6.

Matrix Spike/Matrix Spike Duplicate Analyses (MS/MSD)--A minimum of 5% of the samples will be split and spiked with selected target analytes. Whenever possible, samples which were collected in duplicate should be chosen for MS/MSD analyses. This sample will be split in the laboratory and each fraction will be carried through all of the stages of sample preparation and analysis. If spike recoveries do not meet the acceptance criteria, a LCS must be analyzed to verify that the analytical system is in control. If the LCS recovery is acceptable, qualify the sample results as suspect due to matrix problems. If the matrix spike duplicates do not meet the precision limits published in the methods, evaluate the system for the source of the imprecision.

Analysis of Duplicate Samples--Ten percent of the samples will be analyzed in duplicate. This sample will be split in the laboratory and each fraction will be carried through all stages of sample preparation and analysis. Duplicate analysis will be compared for each element of interest. If agreement for the duplicate analyses is not within the precision limits for the method (or the current control limits), a second set of duplicate analyses will be performed. No further samples should be analyzed until acceptable agreement is achieved for the duplicate analyses.

Mass Spectrometer Sensitivity Check--If the extracted ion current profile (EICP) area for any internal standard changes by more than a factor of two (-50% - +100%), the mass spectrometer must be inspected for malfunctions and correction action taken. Samples analyzed while the system was malfunctioning must be reanalyzed.

Daily GC/MS Performance Tests--Each day that analyses are performed, the GC/MS system will be checked using decafluorotriphenylphosphine (DFTPP) for semivolatiles and bromofluorobenzene (BFB) for volatile organics. The acceptance criteria presented in Table 5-6 must be met prior to performing any analyses. If all criteria are not met, the instrument will be returned and the test repeated until all criteria are achieved.

Quality Control for Metals Analyses by ICPES

The quality control procedures associated with metals analyses are described in SW-846 Method 6010 for ICPES and include:

- Calibration;
- Analysis of Laboratory Control Samples;
- Calibration blank analyses;
- Reagent blank analyses;
- Analysis of matrix spike/matrix spike duplicates;

- Instrument check standard analyses; and
- Interference blank analyses.

These procedures are described below.

Calibration--Calibration procedures are described in Section 5.7.

Laboratory Control Sample Analyses--Immediately after calibration, a laboratory control sample (LCS) containing all elements of interest will be analyzed. The results will be calculated prior to analyzing any other samples. If the measured value differs from the theoretical value for any parameter by more than ±10%, these parameters will be restandardized. The QC standard will be prepared from a stock standard solution which is different than that from which the calibration standards were prepared. Alternatively, it may be purchased from a commercial source. The LCS should be prepared in the same acid matrix as the calibration standards at 10 times the instrumental detection limit or in the mid-calibration range. Measured values should be plotted on a QC control chart. To ensure the continuity of QC control charts, the same QC standard should be used throughout the project.

After every 10 samples, the QC standard will be reanalyzed. If the measured value differs from the theoretical value by more than ±10% for ICPES, the instrument will be recalibrated.

Calibration Blank--At a frequency of 10%, a calibration blank will be analyzed during sample analyses. As specified in SW-846 Method 6010, this standard is prepared by diluting 2 mL of (1+1)HNO_3 and 10 mL of (1+1)HCl to 100 mL deionized water. If response to this standard is verified to be outside three standard deviations of the mean calibration blank value, then the problem will be corrected, the instrument recalibrated, and the previous ten samples reanalyzed.

Reagent Blank--A reagent blank, containing all the reagents and in the same volumes as used in the processing of the samples, and carried through the complete preparation and analysis procedures, will be analyzed at a minimum frequency of 5 percent, or one per sample batch. Reagent blank results can be used to correct for possible contamination resulting from varying amounts of the acids used in processing samples.

Matrix Spike/Matrix Spike Duplicate--Matrix spike and matrix spike duplicate samples will be analyzed for a minimum of 5% of the samples. Matrix spike results should fall within 75-125% recovery of the spike. If the spike is not recovered within the specified limits, the data should be flagged as suspect due to matrix effects. Depending on the data criticality, provisions should be established to use standard-addition analysis procedures to compensate for matrix effects.

Duplicate spike sample results should agree within relative percent difference (RPD) of 20. If they do not, the system will be evaluated for the source of the imprecision, and the problem corrected.

Interference Check Standard--The interference check standard will be analyzed at the beginning and end of an analytical run. This standard contains the analytes of interest at minimal concentrations with known concentration of interfering elements. If results exceed 20% of the mean analysis value for this standard, instrument recalibration will be performed before sample analysis may proceed.

Specific Ion Electrode Determination of Fluoride Quality Control

Fluoride analyses will be performed according to EPA Method 340.2. Quality control procedures include:

- Multipoint calibration;
- Method blank analyses;
- Analyses of Laboratory Control Samples;
- Duplicate analyses; and
- Analyses of matrix spiked samples.

Calibration--Calibration procedures are described in Section 5.7. The method specifies a daily multipoint calibration, followed by periodic verification.

Method Blank Analyses--A minimum of one reagent blank per sample batch (minimum 10%) will be analyzed to determine whether contamination or memory effects have occurred.

Laboratory Control Sample Analyses--A Laboratory Control Sample, prepared independently of calibration standards, should be analyzed every 10 samples. Recovery should be within ±10% of the expected value.

Duplicate Analyses--A duplicate analysis or matrix spike duplicate analysis should be run every 10 samples. The duplicate run should include the whole sample-preparation and analytical process. Precision should be within 10% RPD.

Matrix Spike Analyses--An aliquot of sample should be spiked and analyzed for a minimum of 5% of the samples. Recovery of the spike should be within 15% of the amount added.

Colorimetric Determination of Chloride Quality Control

Titrimetric determination of chloride will be performed according to EPA Method 325.2. Quality control procedures include the following:

- Multipoint calibration;
- Laboratory Control Sample analyses;
- Method blank analyses;
- Duplicate analyses; and
- Matrix spike analyses.

Multipoint Calibration--A multipoint calibration curve ($r \geq 0.995$) will be prepared daily, as described in Section 5.7.

Laboratory Control Sample Analyses--A chloride QC check standard is analyzed every 15 samples. Recovery within 90-110% of the expected value is required for analyses to proceed.

Method Blank Analyses--A blank sample is analyzed with every batch of routine samples (maximum 20) to assess memory effects.

Duplicate Analyses--A duplicate analysis (or matrix spike duplicate) is analyzed every 20 samples. The duplicate analysis should include all sample preparation steps. Precision should be within 15% RPD, or a third value should be obtained and the data flagged.

Matrix Spike Analyses--An aliquot of sample will be spiked and analyzed for a minimum 5% of the samples. Recovery of the spike should be within 20 percent of the expected value; if not, the data will be flagged.

Ion Chromatography Quality Control

Sulfate will be measured by ion chromatography according to EPA Method 300.0. Quality control procedures include the following:

- Laboratory Control Sample analyses;
- Method blank analyses;
- Duplicate analyses; and
- Matrix spike analyses.

Laboratory Control Sample Analyses--A sulfate QC check standard is analyzed every 10 samples. Recovery within 90-110% of the expected value is required for analyses to proceed.

Method Blank Analyses--A blank sample is analyzed with every batch of routine samples (maximum 20) to assess memory effects.

Duplicate Analyses--A duplicate analysis (or matrix spike duplicate) is analyzed every 20 samples. The duplicate analysis should include all sample preparation steps. Precision should be within 15% RPD, or a third value should be obtained and the data flagged.

Matrix Spike Analyses--An aliquot of sample will be spiked and analyzed for 5% of the samples. Recovery of the spike should be within 20% of the expected value; if not, the data will be flagged.

Colorimetric Determination of Nitrate/Nitrite Quality Control

Colorimetric determination of nitrate will be performed according to EPA Method 353.1. Quality control procedures include the following:

- Multipoint calibration;
- Laboratory Control Sample analyses;
- Method blank analyses;
- Duplicate analyses; and
- Matrix spike analyses.

Multipoint Calibration--A multipoint calibration curve (r $\geq$0.995) will be prepared daily, as described in Section 5.7.

Laboratory Control Sample Analyses--A QC check standard is analyzed every 10 samples. Recovery within 90-110% of the expected value is required for analyses to proceed.

Method Blank Analyses--A blank sample is analyzed with every batch of routine samples (maximum 20) to assess memory effects.

Duplicate Analyses--A duplicate analysis (or matrix spike duplicate) is analyzed every 20 samples. The duplicate analysis should include all sample preparation steps. Precision should be within 25% RPD, or a third value should be obtained and the data flagged.

Matrix Spike Analyses--For each batch of samples of a matrix type (20 maximum), an aliquot of sample will be spiked and analyzed. Recovery of the spike should be within 20% of the expected value; if not, the data will be flagged.

pH, Temperature, Conductance Quality Control

Determination of pH, temperature, and conductance will be performed according to EPA Methods 150.1, 170.1, and 120.1, respectively. Each of these determinations will be made using field instruments which have been calibrated as described in Section 5.7.

Laboratory Control Sample Analyses--A QC check standard will be analyzed twice daily for pH and conductance. Results for pH measurements should be within 0.1 pH units, and results for conductance should be within 10% of the standard value.

Duplicate Analyses--Duplicate measurements will be performed at a 5% frequency for pH and conductance and at a 10% frequency for temperature. Duplicate results should agree with ±0.2 pH units and 10% CV for conductance and 1°C for temperature.

5.9.2 Field Quality Control

In addition to the laboratory QC procedures just described, samples will be collected on site for field quality assurance/quality control. This includes collection of trip and field (ambient conditions and/or equipment) blanks and duplicate samples. These procedures are described below.

Water samples will be collected using the sampling techniques discussed in Section 4.0. Quality control procedures will be an integral part of each sampling methodology. These procedures will focus upon ensuring the collection of representative samples which are free from external contamination. Although different extraction and/or analytical procedures will be used for the various parameters of interest, certain general quality control procedures are applicable to all methods. These include the following:

- One trip blank will accompany each shipment of samples sent to the laboratory for analysis of volatile organic contaminants.

- Equipment blanks will be collected for all analytical parameters, at a frequency of one per day.

- Duplicate (i.e., split) samples will be collected at a frequency of approximately 10% to provide a measure of method variability (i.e., total variability due to imprecision in sampling, handling, and analytical procedures).

- Matrix spike/matrix spike duplicate pairs will be collected at a frequency of approximately 10% to assess potential matrix effects on analyte recovery.

- Chain of custody forms will accompany all samples.

- Sampling apparatus will be thoroughly cleaned between uses to prevent cross-contamination of the samples. (See Section 2 for details.)

5.10 Preventative Maintenance

The primary objective of a preventative maintenance program is to help ensure the timely and effective completion of a measurement effort. Radian's preventative maintenance program is designed to minimize crucial sampling and/or analytical equipment down time due to expected or unexpected component failure. In implementing this program, efforts are focused in three primary areas:

- Establishment of maintenance responsibilities;

- Establishment of maintenance schedules for major and/or critical instrumentation and apparatus; and

- Establishment of an adequate inventory of critical spare parts and equipment.

Each of these efforts are discussed in the following sections.

5.10.1 Maintenance Responsibilities

Equipment and apparatus used in Radian's environmental measurement programs fall into two general categories:

- Equipment which is permanently assigned to a specific laboratory (e.g., GC Laboratory, GC/MS Laboratory, etc.); and

- Equipment which is available for field or laboratory use on an as-needed basis (e.g., field sampling equipment, mobile laboratories, etc.).

Maintenance responsibilities for permanently assigned equipment are assigned to the respective laboratory managers. The laboratory managers then establish maintenance procedures and schedules for each major equipment item. Specific responsibilities for specific items may be delegated to laboratory personnel, although the laboratory managers retain responsibility for ensuring adherence to prescribed protocol.

Maintenance responsibilities for non-assigned equipment are coordinated through the Project Director. Equipment in this category includes source sampling equipment, real-time emissions monitoring instrumentation, and mobile laboratories and associated instrumentation. All equipment in this category is available for project-specific measurement efforts on an as-needed basis. This requires three related maintenance efforts:

- Ensuring that available equipment is functional and ready for use;

- Maintenance during use; and

- Check-out and servicing after use.

Two instrument technicians in the Radian Physical Chemistry Division have, as their primary duty, the responsibility for ensuring that available equipment and instrumentation are ready for use, and that returned equipment is checked out, serviced, and returned to available inventory in a timely manner. Maintenance during use is the responsibility of the project team using the equipment.

5.10.2 Maintenance Schedules

The effectiveness of any maintenance program depends to a large extent on adherence to specific maintenance schedules for each major equipment item. A schedule is established for all routine maintenance activities (Table 5-7). Other maintenance activities may also be identified as requiring attention on an as-needed basis. Manufacturers' recommendations provide the primary basis for the established maintenance schedules, and manufacturers' service contracts provide primary maintenance for many major instruments (e.g., GC/MS instruments, atomic absorption spectrometers, analytical balances, etc.). Maintenance activities are documented in a maintenance log which indicates the required frequency for each procedure and provides for dated entries.

5.10.3 Spare Parts

Along with a schedule for maintenance activities, an adequate inventory of spare parts is required to minimize equipment down time. This inventory should emphasize those parts (and supplies) which:

- Are subject to frequent failure;
- Have limited useful lifetimes; or
- Cannot be obtained in a timely manner should failure occur.

Table 5-7

Instrument Maintenance Schedule

Instrument	Maintenance	Frequency
AA	Tuning/Service Call	Quarterly
	Clean Fan Filter	Annually
	Replace Lamps	As Needed
	Change Tubing	As Needed
	Clean Windows	As Needed
	Clean or Replace Cones	As Needed
ICPES	Check Disc Drive	Daily
	Run Diagnostics	Daily
	Clean Torch	Weekly
	Clean Nebulizer	Weekly
	Clean Fan Filter	Monthly
	Replace Pump Oil	Quarterly
	Replace Tubing	As Needed
HPLC	Pressure check and maintatined	Daily
	Pump Maintenance	As Needed
	Replace Column	As Needed
	Replace Filters	As Needed
GC	Clean Fan Filter	Quarterly
	Replace Column	As Needed
	Detector Maintenance	As Needed
	Replace Septa	As Needed
GC/MS	Clean Fan Filter	Quarterly
	Replace Vacuum Pump Oil	Semi-Annually
	Replace Filaments	As Needed
	Clean Ion Source	As Needed
	Replace Electron Multipliers	As Needed
	Replace Septa	As Needed
	Replace Column	As Needed
	Replace Injector Liners	As Needed
	Replace Organic Filters	As Needed
	Replace Oxygen Traps	As Needed
Technicon Auto Analyzer	Replace Pump Oil	Monthly
	Clean Rollers	Weekly
	Lubricate Rollers	Bi-Weekly

Table 5-7

(Continued)

Instrument	Maintenance	Frequency
Balances	Service	Annually
OVA-FID	Recharge or Replace Battery Monitor Fuel and/or Combustion Air Supply Gauges Perform Routine Maintenance as Described in the Manual Check for Leaks	As Needed Hourly As Needed Daily
PID	Recharge or Replace Battery Replace or Clean Lamps Clean or Replace Filter Check for Leaks	As Needed As Needed As Needed Daily
pH Meter	Check Fuse and Sensor Clean Meter Rinse Probe	Weekly As Needed After Each Measurement
Conductivity Meter	Clean Meter	As Needed
Water Level Meter	Clean Meter Wipe Probe Dry and Place Into Probe Holder Recharge or Replace Battery	As Needed After Each Measurements As Needed
Thermometer	Clean Replace	As Needed If broken or mercury separates

Field sampling task leaders and the respective laboratory managers will be responsible for maintaining an adequate inventory of necessary spare parts. In addition to spare parts and supplies inventories, Radian's non-assigned equipment represents an extensive in-house source of back-up equipment and instrumentation.

5.11 Assessment of Precision, Accuracy, and Completeness

The QC analyses conducted during this project are designed to provide a quantitative assessment of the measurement data. The two aspects of data quality which are of primary concern are precision and accuracy. Accuracy reflects the degree to which the measured value represents the actual or "true" value for a given parameter, and includes elements of both bias and precision. Precision is a measure of the variability associated with the measurement system. The completeness of the data will be evaluated based upon the valid data percentage of the total tests conducted.

5.11.1 Precision and Accuracy

Precision and accuracy objectives, in terms of maximum allowable imprecision and inaccuracy, for the various chemical parameters in clean-matrix laboratory samples are presented in Table 5-1 and 5-2 for groundwater and soils, respectively. Data capture objectives for all constituents are 90%. Precision values represent a measure of variability for replicate measurements of the same parameter in clean-matrix, laboratory QC samples, expressed in terms of the coefficient of variation (CV, or relative standard deviation). The CVs are calculated from data such as a series of continuing calibration results and Laboratory Control Sample (LCS) results. Accuracy values for clean-matrix laboratory samples include components of both random error (i.e., variability due to imprecision) and systematic error (i.e., bias), and thus reflect the total analytical error for a given measurement, expressed as percentage of the true value. The average relative percent difference between true and measured concentrations in continuing calibration and LCS samples may be compared to accuracy objectives in Table 5-1 and 5-2. The basis for these estimates are described in the methods. The analytical laboratory will be able to document that the QA/QC procedure in each standard method in Chapter One and Method 8000 of SW-846, 3rd edition; Method 1020 of Standard Methods for Examination of Water and Wastewater, 17th edition; or other applicable method guidance, was followed for all analytical work. Accuracy and precision estimates for samples in a natural matrix (which is more difficult from an analytical standpoint) would not be expected to be within the objectives presented in Tables 5-1 and 5-2.

5.11.2 Blanks

One other group of QC checks which will address measurement bias will be blanks. Instead of assessing and controlling overall accuracy, field and laboratory blanks will be used to control bias due to sample contamination, and to assess the extent to which the source of bias impacts the measurement results. Since sample contamination generally occurs at relatively low concentrations, the effects of contamination are most pronounced, in terms of relative error, for low concentration samples. By effectively increasing "background noise," the lower detection limit of a measurement method is affected.

Laboratory blanks will be used to control contamination introduced during sample preparation and analysis. This will be done by establishing acceptability limits for blank results in much the same manner as limits are established for the other QC checks. Laboratory blanks will also be used to assess method detection limits. Method detection limits will be defined as the average blank concentration plus three times the standard deviation of replicate measurements made at or within five times the detection limit.

Field blanks will be used primarily to assess the overall magnitude and extent of contamination. Contamination introduced during sample collection may be estimated from the difference between field and laboratory blank results. Some types of field blanks, such as equipment blanks, will be used primarily in a qualitative role.

5.11.3 Completeness

Measurement data completeness is a measure of the extent to which the database resulting from a measurement effort fulfills objectives for the amount of data required. For this program, completeness will be defined as the valid data percentage of the total tests conducted. The project will be considered complete if 90% of the measurement data is valid.

5.12 Corrective Action

Each measurement system must initially satisfy specific criteria for calibration linearity, reference material recovery, and freedom from contamination. Thereafter, control samples are analyzed at a 10% frequency to monitor any changes in the quality of the data being produced. An out-of-control condition is defined as:

1) Detection of any compounds of interest in a reagent blank at >5 times the limit of detection.

2) Failure to meet the acceptance criteria for recovery of <u>any compound</u> of interest in a QC sample.

3) Exceeding the action limit for matrix spike recovery and subsequent failure to meet the acceptance criteria for a Laboratory Control Sample for the same parameter(s) which failed the matrix spike test. Any parameter which fails the matrix spike test but not the Laboratory Control Sample test will be flagged as a suspect result for the parameter due to matrix effect.

When an out-of-control situation is detected, efforts are undertaken to determine the cause. Procedures related to corrective action are described below.

During the course of the field investigation, it will be the responsibility of the Project Director, Supervising Geologist, and sampling team members to see that all measurement procedures are followed as specified and that measurement data meet the prescribed acceptance criteria. In the event a problem arises, it is imperative that prompt action be taken to correct the problem. Problems requiring major corrective action will be documented by the use of Quality Control Exception Reports (QCER). The QA Coordinator will be included in the distribution for each QCER issued for this program. The Project Director or Supervising Geologist will initiate corrective action in the event of QC results which exceed acceptability limits or upon identification of some other problem or potential problem. Corrective action may also be initiated by the QA Coordinator based upon QC data or audit results. Acceptability limits and prescribed corrective actions related to the various internal QC checks are discussed in Section 5.10.

In addition to the malfunction reporting system for addressing problems identified from within the program through the internal quality control system, a system for issuing formal Recommendations for Corrective Action (RCAs) exists for addressing problems identified through independent quality assurance review. RCAs may be issued only by a member of the Research and Engineering Quality Assurance (QA) Group, or by their designee in a specific QA role. Each RCA addresses a specific problem or deficiency, usually identified during QA audits of laboratory or project operations. Although the RCA system (and form) provides for distinguishing among problems of different urgency, RCAs are typically issued only to address significant, systematic deficiencies. Each of these formal written recommendations requires a written response from the responsible party (i.e., to whom the RCA was issued). A system has been established to track these RCAs and the corresponding responses. On a monthly basis a summary report of the "unresolved" RCAs is prepared by the QA group and issued to the work areas that each manager is responsible for and the current status of each. Each RCA requires the response and verification by the QA group that the corrective action has been implemented before the status is changed on the monthly report. In the event that there is no response to an RCA within 30 days, or the proposed corrective action is disputed, the recommendation and/or conflict is pursued to successively higher management levels until the issue is resolved.

5.13 Quality Assurance Reporting

Effective management of a field sampling and analytical effort requires timely assessment and review of field activities. This will require effective interaction and feedback between the field team members, Supervising Geologist, Project Director, and the QA Coordinator.

The Supervising Geologist and appropriate project team members will be responsible for keeping the QA Coordinator and Project Director up to date regarding the status of their respective tasks so that quick and effective solutions can be implemented should any data quality problems arise. The use of internal status reports also provides an effective mechanism for ensuring ongoing evaluation of measurement efforts. These status reports may address some or all of the following:

- Summary of activities and general program status;
- Summary of calibration data and QC data;
- Summary of unscheduled maintenance activities;
- Summary of corrective action activities;
- Status of any unresolved problems;
- Assessment and summary of data completeness; and
- Summary of any significant QA/QC problems and recommended and/or implemented solutions not included above.

5.13.1 Quality Assurance Reporting

Raw data which has been validated by the QA Coordinator will be submitted to the Wendover AFAF Project Manager within 50 days of final collection. Also, major project reports will include separate QA/QC sections which summarize audit results and QC data collected during the program.

Problems requiring swift resolution will be brought to the immediate attention of the Project Director via the malfunction reporting/corrective action scheme discussed in Section 5.13.

5.13.2 Quality Control Data Reporting

The Laboratory Technical Director is responsible for reviewing all analytical activities to ensure compliance with the QC requirements outlined in this Work Plan. This review serves as a control function and should be conducted on a daily basis so that deviations from project requirements will be immediately identified and corrected.

A systems review is an on-site, qualitative review of the various aspects of a total sampling system. It is an assessment of overall effectiveness of the sampling program and represents an objective, insightful evaluation of a set of interactive systems with respect to strengths, deficiencies, and potential areas of concern. Typically, the review consists of observations and documentation of all aspects of the sampling effort. The observations are documented in the field logbook.

The sampling systems review is based on adherence to approved quality assurance project plans (QAPP), methods, and standard operating procedures (SOPs). This review may include the following areas:

- Sample collection and handling;
- Calibration procedures and documentation;
- Completeness of dataforms, notebooks, and other reporting requirements;

- Data review and validation procedures;
- Data storage, filing, and recordkeeping procedures;
- Quality control procedures and documentation;
- Operating conditions of facilities and equipment;
- Documentation of maintenance activities; and
- Systems and operations overview.

The sampling systems review does not provide a quantitative measure of quality, but does provide an evaluation of the effectiveness of a quality control program, both in terms of design and implementation.

Sampling Quality Control Review and Reporting Requirements

Sampling activities will be reviewed continuously during the field audit to determine whether the sampling quality control requirements are being fulfilled.

Analytical Quality Control Review and Reporting Requirements

Each data package received will be reviewed by the Project Geologist on a weekly basis for completeness and adherence to the quality control protocol established for each type of analysis. Summary notes will be made for each data package detailing what QC data were reported to support the analytical results. These summary notes will accompany the "data received" summaries each week. Reports will be issued by the QC Coordinator addressing any abnormalities or deviations from the established quality control.

6.0 REPORTING REQUIREMENTS

The activities described in the above sections will be conducted during the early 1993 field season. The data collected during these efforts will be evaluated and described in the PA/SI Report. The report will conform to the Preliminary Assessment guidelines set by the EPA (1991) and will summarize what is known about the site and what is inferred, the activities conducted during the PA, and all information researched. Additionally, the report will summarize the sampling locations, identify the type and, if possible, the extent of contaminants. The deliverables schedule is as follows:

WORK PLAN		
Draft	5 Copies	01-15-93
Air Force Review		02-15-93
Final	25 Copies	03-15-93
PS/SI REPORT		
Draft	5 Copies	09-15-93
Air Force Review		10-15-93
Final	25 Copies	11-15-93

Delivery of drafts of the project report will be to the project manager with only a courtesy copy (cc) of the submittal letter to the contracting officer. Additionally, the submittal letter will clearly show all offices who have received a copy of the transmittal letter. All comments made by the Air Force or Regulators will be addressed in a separate written response to comments' report. These responses to comments will be sent to Hill AFB EMR for review prior to revision of the document. Strict adherence to the above schedule should be followed by the contractor and reviewers of draft copies.

As a part of reporting requirements for the PA/SI at Wendover AFAF/UTTR, the computerized data files will be created and delivered in conformance with the latest version of the Installation Restoration Program Information Management System (IRPIMS) Data Loading Handbook. Approximately 20,000 records will be generated during the investigation, including data for analytical results, location, lithology, and sample chain of custody. The data specified in version 2.2 of the IRPIMS Data Loading Handbook will be compiled for each new sample location and loaded into the project database. Data from the project database will be translated into one batch load file and submitted to the Air Force IRPIMS for subsequent loading. To ensure acceptance of the batch load file, questions from the Air Force or other involved agencies will be satisfied.

7.0 REFERENCES

1. Bedinger, M.S., K.A. Sargent, and W.H. Langer, 1990. Studies of Geology and Hydrology in the Basin and Range Province, Southwestern United States, For Isolation of High-Level Radioactive Waste- Characterization of the Bonneville Region, Utah and Nevada. U.S. Geological Survey Professional Paper 1370-G.

2. Earth Technology Corporation, 1985. Installation Survey Report, Wendover/Hill AFR, Tooele AD.

3. Earth Technology Corporation, 1992. Defense Environmental Restoration Program Formerly Used Defense Sites, Inventory Project Report, Wendover Air Force Auxiliary Field, Tooele County, Utah.

4. Environmental Protection Agency, 1991, Guidance for Performing Preliminary Assessments Under CERCLA, Publication 9345.0-01A.

5. Personal communications with Gene Craner, November, 1992.

6. Personal communication with Bob Scobie, November, 1992.

7. Personal communication with John Grossnickle, November, 1992.

8. Schneyer, J.D., 1984. Master of Arts Thesis: Geology of the Leppy Hills Area, Southern Silver Island Mountains, Near Wendover, Utah.

9. U.S. Air Force, Environmental Technology Application Center (USAFETAC), 1991. Surface Observation Climatic Summaries for Wendover AF Auxiliary, UT.

10. U.S. Department of Agriculture, Soil Conservation Service, 1986, Soil and Range Survey - Air Force Base, Utah (Wendover AFAF and UTTR areas).

11. U.S. Geological Survey, 1988(a), Major Ground-Water Flow Systems in the Great Basin Region of Nevada, Utah, and Adjacent States, Hydrologic Investigations Atlas, U.S. Department of the Interior.

12. U.S. Geological Survey, 1988(b), Hydrogeology of the Great Basin Region of Nevada, Utah, and Adjacent States, Hydrologic Investigations Atlas, U.S. Department of the Interior.

SFUND RECORDS CTR
2081940

Reference 21

Ref 21

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

ELKO COUNTY, NEVADA

(UNINCORPORATED AREAS)

PANEL 575 OF 4375

(SEE MAP INDEX FOR PANELS NOT PRINTED)

COMMUNITY-PANEL NUMBER
320027 0575 B

EFFECTIVE DATE:
FEBRUARY 1, 1984

Federal Emergency Management Agency

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

ELKO COUNTY, NEVADA

(UNINCORPORATED AREAS)

MAP INDEX

PANELS PRINTED: 500, 575, 600, 625, 650, 725, 750, 775, 900, 1000, 1075, 1150, 1200, 1225, 1250, 1400, 1425, 1450, 1500, 1550, 1575, 1600, 1725, 1750, 1775, 1825, 1875, 1900, 1950, 2000, 2100, 2125, 2150, 2175, 2250, 2275, 2325, 2375, 2400, 2439, 2450, 2475, 2491, 2500, 2525, 2700, 2750, 2752, 2754, 2762, 2764, 2775, 2800, 2875, 2975, 2977, 2981, 2983, 2986, 2987, 3000, 3192, 3200, 3203, 3225, 3275, 3500, 3750, 3975, 4000, 4200, 4225

COMMUNITY-PANEL NUMBERS
320027 0001-4375

MAP REVISED:
MARCH 16,1992

Federal Emergency Management Agency

Reference 23

Rq 23

DRAFT
ENVIRONMENTAL ASSESSMENT
AIR INDUSTRIAL PARK AND COMPOST FACILITY

FEBRUARY 24, 1995

Prepared for:

City of West Wendover
P.O. Box 2825
West Wendover City, Nevada 89883

Applied Ecological Services, Inc.
Clock Tower Plaza, Suite 222
550 North Main
Logan, Utah 84321

TABLE OF CONTENTS

	Page
TITLE PAGE	i
TABLE OF CONTENTS	ii
LIST OF FIGURES	v
LIST OF TABLES	iv
ACRONYMS AND ABBREVIATIONS	vii
GLOSSARY	viii
EXECUTIVE SUMMARY	1
INTRODUCTION	1
SOILS, TOPOGRAPHY AND VEGETATION	1
HYDROLOGY	2
GEOLOGY	2
WILDLIFE	3
METEOROLOGY	3
SOCIOECONOMIC	4
ARCHAEOLOGY	4
1.0 PURPOSE OF AND NEED FOR ACTIONS	5
1.1 INTRODUCTION	6
1.2 PURPOSE	6
1.3 NEED FOR ACTIONS	6
2.0 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES	8
2.1 INTRODUCTION	9
2.2 PROPOSED ACTION	9
2.2.1 Air Industrial Park	9
2.2.2 Compost Facility for Sewage Sludge and Municipal Solid Waste (MSW)	13
2.2.3 Alternatives	13
3.0 DESCRIPTION OF AFFECTED ENVIRONMENTS	14
3.1 INTRODUCTION	15
3.2 SOILS, TOPOGRAPHY AND VEGETATION	15
3.2.1 Soils	15
3.2.2 Topography and Vegetation	16
3.3 HYDROLOGY	23
3.3.1 Surface Water	23
3.3.2 Ground Water	23
3.4 GEOLOGY	24
3.5 WILDLIFE	25
3.6 METEOROLOGY	28
3.7 SOCIOECONOMIC	30
3.8 ARCHAEOLOGY (CULTURAL RESOURCES)	31
3.8.1 Summary of Current Knowledge	31
3.8.2 Cultural Setting	34
3.8.3 Prehistoric Cultural Chronology	35
3.8.4 Ethnographic Data	37
3.8.5 Early History	38
3.8.6 Environmental Setting	38

TABLE OF CONTENTS (Cont.)

	Page
3.8.7 Research Goals and Objectives	39
3.8.8 Survey Procedure	39
3.8.9 Survey Results	40
3.8.10 Archaeological Sites	40
3.8.11 Archaeological Isolates	45
3.8.12 Assessment of Significance	45
4.0 ENVIRONMENTAL CONSEQUENCES OF PROPOSED ACTIONS	49
4.1 INTRODUCTION	50
4.2 SOILS, TOPOGRAPHY AND VEGETATION	50
4.2.1 Soils	50
4.2.2 Hazardous Materials	50
4.2.3 Topography and Vegetation	51
4.2.4 Threatened and Endangered Plants	52
4.2.5 Jurisdictional Wetlands	52
4.3 HYDROLOGY	55
4.3.1 Surface Water Quality	55
4.3.2 Ground Water Quality	55
4.4 GEOLOGY	56
4.5 WILDLIFE	56
4.6 METEOROLOGY	56
4.7 SOCIOECONOMIC	57
4.8 ARCHAEOLOGY (CULTURAL RESOURCES)	57
4.8.1 Management Recommendations	57
5.0 PREPARERS OF ENVIRONMENTAL ASSESSMENT	59
6.0 ORGANIZATIONS AND PEOPLE TO WHICH COPIES WERE SENT	61
7.0 PERSONS AND AGENCIES CONSULTED	63
7.1 PERSONAL INTERVIEWS	64
7.2 AGENCIES CONSULTED	65
7.3 MEETINGS HELD WITH AGENCIES AND GOVERNMENTAL LEADERS	65
7.3.1 Meeting: Nevada Division of Environmental Protection, Carson City, Nevada May 4, 1994	65
7.3.2 Meeting: Elko County, Nevada Commission Meeting, July 20, 1994	66
7.3.3 Meeting: West Wendover City Council, West Wendover City, Nevada, January 17, 1995	66
7.3.4 Meeting: Wendover, Utah, City Council, January 17, 1995	67
7.3.5 Meeting: Tooele County Commission, Tooele, Utah, January 24, 1995	67
8.0 REFERENCES	68
8.1 SOILS, TOPOGRAPHY AND VEGETATION	69
8.2 HYDROLOGY	70
8.3 GEOLOGY	70
8.4 WILDLIFE	70

TABLE OF CONTENTS (Cont.)

	Page
8.5 METEOROLOGY	71
8.6 SOCIOECONOMIC	71
8.7 ARCHAEOLOGY	71
9.0 APPENDICES	75
A. ACTION TAKEN BY THE ELKO COUNTY COMMISSION AND THE WEST WENDOVER CITY COUNCIL BETWEEN 1982 AND 1993	76
B. CERTIFICATE OF (SUB-SURFACE) CLEARANCE, 391.98 ACRES	78
C. RIGHT-OF-WAY GRANT/TEMPORARY USE PERMIT, 200 ACRES	80
D. SCOBIE ROAD RIGHT-OF-WAY	83
E. CERTIFICATE OF (SURFACE) CLEARANCE, 1,357.64 ACRES	86
F. AGENDA, TOOELE COUNTY, COUNTY COMMISSIONERS MEETING	88

LIST OF FIGURES

Figure		Page
1.	Map showing West Wendover City, Wendover Air Force Auxiliary Field, Wendover Airport and surrounding cities	7
2.	Map showing the boundary of the 1,357.64 acres considered for relinquishment by the U. S. Air Force and the Bureau of Land Management and the 199.91 acres granted in perpetuity to West Wendover City by the Bureau of Land Management in a Right-of-Way Grant/Temporary Use Permit	10
3.	West Wendover City, Master Land Use Plan which incorporates the proposed Air Industrial Park within future city limits	11
4.	Proposed land use map of the Air Industrial Park. The park will be divided into three areas, 1. Air Park - 800 acres, 2. Commercial Park - 176 acres and 3. Future development of a Railroad Industrial Park - 410 acres	12
5.	Shadscale desert shrub vegetation showing pebble mulch between plants (looking southeast)	17
6.	Black greasewood shrubs (looking south)	17
7.	Barren hills (soil mounds) formed by erosion of saline soil deposits. Because of the dry and salty soil little vegetation grows on these sites. Occasionally iodine bush grows on or around these hills	19
8.	Erosion and piping of soil in northeast corner of study area (looking northeast). No water was observed in these 3′ deep exposed holes indicating a deep water table. The Wendover, Utah airport is seen in background	19
9.	Inland saltgrass vegetation (looking southeast)	20
10.	Iodine bush vegetation (looking northeast). Ceramic sewer pipeline is exposed near the surface	20
11.	Old sewer treatment facility (looking southwest). Tamarisk trees and black greasewood plants grow around the facility	21
12.	One-fourth acre sewage lagoon or pond as seen from within (looking north). Saltmarsh bulrush is seen in foreground and tamarisk trees in background. This area continues to catch and retain runoff from surrounding areas and the old pipeline	21

LIST OF FIGURES (Cont.)

Figure | Page

13. Map showing locations of previous survey coverage within the study area (C refers to the Scobie Road Project and D refers to the West Wendover Sewage Lagoons Project), and previously documented archaeological sites 42T0708, CRNV-11-2833, and CRNV-11-6094. Adapted from the USGS Wendover, Nevada-Utah 7.5′ series quadrangle 33

14. Map showing locations of newly recorded archaeological sites within the project area. Adapted from the USGS Wendover, Nevada-Utah 7.5′ series quadrangle 41

15. Map showing locations of isolated artifacts within the project area. Adapted from the USGS Wendover, Nevada-Utah 7.5′ series quadrangle 42

LIST OF TABLES

Table Page

1. Population growth of West Wendover City between 1986 and 1994 and projected growth by the year 2000 30

2. Number of hotel/motel rooms available in West Wendover City in 1991, 1994 and projected to 2000 31

3. Description and location of archaeological project area isolates 46

ACRONYMS AND ABBREVIATIONS

AFAF	Air Force Auxiliary Field
BLM	Bureau of Land Management
Corps	U. S. Army Corps of Engineers
CPT	Cone penetrometer
EPA	Environmental Protection Agency
mg/kg	Milligram/kilogram
msl	Mean sea level
PCB	Polychlorinated biphenyls
RCRA	Resource Conservation and Recovery Act
SCS	Soil Conservation Services
TCL/TAL	Total Compound List/Target Analyte
USACE	U. S. Army Corps of Engineers
VOC	Volatile organic compound

GLOSSARY

alluvial: A deposit of sand, mud, etc., formed by flowing water.

alluvial fan: A triangular wedge of stream-deposited unconsolidated sediment located along the margin of a mountain range which broadens out into the valley adjacent to the mountain range and has its apex at the mouth of a canyon.

aquifer: A body of rock that is sufficiently permeable top conduct groundwater.

archaeology: The study of prehistoric and early historic cultures and processes of cultural adaptation and change, relying mostly upon the material remains associated with those societies.

archaeological assessment: An aspect of cultural resource management in which the surface of a project area is systematically covered by pedestrian survey in order to locate, document, and evaluate archaeological materials therein.

archaic tradition: In the New World, a cultural stage denoting a lifestyle generally lacking horticulture, domesticated animals, and permanent villages. In western North America, archaic groups consisted mostly of small, highly mobile hunter-gatherer bands.

artifact: Any object manufactured or modified by humans that can be picked up or removed from the ground without affecting its integrity (as opposed to an archaeological feature).

asbestos: Incompatible, chemical-resistant fibrous mineral forms of impure magnesium silicate which may be injurious to human health.

atlatl: An Aztec term for spear thrower, a wooden shaft or board used to propel a long, composite spear/dart equipped with a relatively large flaked stone dart point.

biface: A stone tool that has been flaked on both sides (faces).

biface thinning flake: A flake that has been removed from a biface through percussion as part of the reduction process.

B.P.: A term denoting "years before present" in which one counts backward from A.D. 1950. This designation usually is associated with uncalibrated radiocarbon dates.

Cambrian: A the oldest subdivision within the Paleozoic, between about 570 and 500 million years before present.

carbonate rocks: The term used to refer collectively to limestones and dolomites.

Cenozoic: A unit of geologic time between about 66 million years ago and the present.

colluvium: Any unconsolidated sediment on the surface of the earth that was not deposited by a stream.

compost: For this Environmental Assessment a soil produced by mixing sewage sludge and municipal solid waste.

coprolite: Desiccated human feces often found preserved in prehistoric cave sites or low desert open-air sites. Coprolite analysis provides excellent information concerning prehistoric subsistence systems.

core: A piece of stone from which flakes and flake blanks were removed and subsequently fashioned into tools. Cores can be classified as bifacial, unidirectional, or multidirectional, and may themselves be used as tools at some point in their use life.

debitage: Thin, usually small pieces of stone resulting from flaked stone tool production and maintenance.

dolomite: The name used both for a mineral composed of calcium-magnesium carbonate and for a rock comprised predominantly of this mineral.

effective porosity: The percent of total volume of a given mass of soil that consists of interconnecting voids.

evaporites: The term used to refer collectively to deposits of the mineral halite (rock salt) and gypsum.

feature: Any object made or modified by humans, typically incorporated into the ground, and which cannot be removed from its location without affecting its integrity such as a fire hearth, a storage pit, a burial, or rock art panel.

ferrous: Containing or pertaining to iron.

ferrous ordnance detector: An instrument that detects ferrous material down to a depth of 10 feet.

ground stone: Stone implements formed primarily by abrasion and pecking, and often used to process plant foods, although many groups used ground stone tools such as manos and metates and mortars and pestles to grind pigment and to process small animals.

habitat: A place in which animals plants and other organisms live or grow.

hearth area: The remains of a prehistoric fireplace often represented by one or more of the following: ash, charcoal, fire-cracked rock, burnt floral and faunal remains, and soil discoloration.

Holocene: The current geological epoch that began at the end of the Pleistocene epoch (ca. 8000 B.C.) and which is generally characterized by a warmer climate than that of the Pleistocene.

hummock: A small knoll or hillock above a marshy region.

hydraulic conductivity: The rate of flow of water in ft^3/day through a cross section on one square foot under a unit hydraulic gradient. Describes the ability of soil to conduct water.

hydraulic gradient (in an unconfined aquifer): The rate of change of groundwater table elevation per unit distance in the direction of flow.

hydric soils: Soils that have developed under wet conditions sufficiently to develop characteristic color and chemical properties such at mottling.

hydrophytic plants: Plants that thrive or grow well in water-saturated or inundated soils.

inundated: Submerged under water.

isolate: One or two artifacts occurring by themselves and not associated with an archaeological site, and generally thought to represent items lost or discarded by people as they moved through an area.

jurisdictional wetlands: Wetland under the jurisdiction of the U.S. Army Corps of Engineers for the purposes of permitting and regulating development activities. Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

lacustrine: Geological strata formed at the bottom of lakes.

Lake Bonneville: A large lake that existed during the Pleistocene in what is now northwestern Utah. The Great Salt Lake is a much smaller remnant of this lake.

Leppy Hills: Hills to the immediate north and west of West Wendover City.

lithic: Of or pertaining to stone.

lithic scatter: An archaeological site consisting of a concentration of waste flakes and complete or fragmentary flaked stone tools such as projectile points and bifaces.

limestone: A rock comprised predominantly of the mineral calcite, which is composed of calcium carbonate.

locus: A distinct portion of an archaeological site, typically separated from other parts of the site by space void of cultural materials. Many open air sites consist of various loci spread over a relatively large area.

ordnance: Military supplies including weapons and ammunition.

Paleozoic: A unit of geologic time between about 570 and 245 million years before present.

permeability: The state of soils that allow water and soils gases to pass through it.

physiographic province: A geographic region that is characterized by similar topographic features. The Basin and Range physiographic province lies between the Wasatch Mountains on the east and the Sierra Nevada Mountains on the west, and is characterized by north-south trending mountain ranges separated by internally drained valleys.

Pinto: A term applied to a widespread and poorly understood early and middle archaic cultural complex of the Desert West and the distinct atlatl dart points associated with it.

playa: A dry desert lake bed.

Pleistocene: The last major geological epoch, lasting from approximately 1.8 million to 10,000 years ago. This time was characterized by cooler temperatures and lower sea levels than today and by the advance and retreat of extensive glaciers.

polychlorinated biphenyls: Industrial compounds produced by chlorination of biphenyl and accumulates in animal tissue.

pore-water velocity: The velocity of groundwater flowing through interconnected pores.

Quaternary: The other subdivision of the Cenozoic that immediately follows the Tertiary, between about 2 million years ago and the present.

radon: A heavy radioactive gaseous element formed by disintegration of radium.

rhizomes: Underground stems of plants that store and transport nutrients.

sewage sludge: For this Environmental Assessment a sewage material that has had all of the plastic removed and 85-90 percent of the water removed from the waste.

scarify: To break up the surface of topsoil. The land where the sewer treatment plant is now located, was scarified to a depth of two feet.

succulent: Plants that have plentiful juice or cellular fluids.

survey: In archaeology, a systematic examination of land to document the archeological resources located therein.

Tertiary: A subdivision of the Cenozoic, between about 66 million and 2 million years before present.

transect: A linear survey route covered by archaeologists to locate cultural resources.

Triassic: The subdivision of geologic time immediately following the Paleozoic, between about 245 and 210 million years before present.

unconfined aquifer: Aquifer that has a free water table, i.e., is not confined under pressure beneath relatively impermeable rocks.

unconsolidated sediment: A sediment that is loosely arranged or unstratified.

water reclamation facility: Facility that removes waste and reclaims non-potable water from sewage water. This water is used in West Wendover City, to irrigate the Toana Vista golf course, parks and other city recreational facilities.

VEGETATION

Vegetation of the study area is a salt-desert shrub type. Plant cover and species diversity are relatively low in this habitat type. The principle perennial species are iodine bush (*Allenrolfea occidentalis* - also called pickleweed), black greasewood (*Sarcobatus vermiculatus*), shadscale (*Atriplex confertifolia*), inland saltgrass (*Distichlis spicata*), and tamarisk or salt cedar. A few annual herbs such as halogeton (*Halogeton glomeratus*) and summer-cypress (*Kochia scoparia*) are also present along roadsides and other disturbed areas.

No threatened or endangered plant species were observed during visits to the site or have been reported to occur in this area. Field indicators of hydrophytic plants and hydric soils suggest that the low-lying portions of the study area may be considered wetlands under the jurisdiction of the U.S. Army Corps of Engineers (Corps) which could restrict most development activities. An evaluation of the site hydrology will need to be made to determine whether the area meets the third field indicator required to classify portions of the areas as jurisdictional wetlands. Special permitting and mitigation may be required for such areas prior to development, if they are delineated as jurisdictional wetlands. The delineation of the boundaries of jurisdictional wetlands will have to be made by either a private consultant approved by the Corps or the Corps in Reno, Nevada before the proposed alternatives can be implemented.

HYDROLOGY

Surface water in the areas adjacent to the site does not form permanent, natural streams or lakes. Occasionally, surface water forms temporary shallow ponds. Any potential surface water contamination would occur during periods of flash flooding, and be caused by dissolution of constituents present in surficial soil into the aqueous phase. The transport distance of such contaminated surface water would be quite limited due its evaporation and infiltration. Thus, the potential for exposure via surface water is not present.

Ground water contamination at the site is minimal, and does not warrant any mitigation except for possible wetland designation. The groundwater in the vicinity of the site is not used for drinking or as a resource. In addition, there are no wellhead protection zones in the area. Thus, there is no clear potential for exposure through the groundwater pathway.

GEOLOGY

The Wendover AFAF lies within a region which consists of linear, north-south trending mountain ranges separated by valleys, many of which are underlain by thick sequences of unconsolidated basin-fill sediments.

EXECUTIVE SUMMARY

INTRODUCTION

This Environmental Assessment examines 1,357.64 acres of land, adjacent to the City of West Wendover, Nevada presently owned by the U. S. Air Force and the Department of Interior, Bureau of Land Management. The land is needed by West Wendover City to develop an Air Industrial Park and thus expand their tax base beyond the present businesses of gaming and tourism.

This EA addresses potential impacts of the proposed action, evaluating them by comparison with baseline information. Alternatives were not considered, as no action would leave the land in its present undeveloped state.

SOILS

Surface soils at the study area are characterized as basin fill deposits consisting mainly of non-inundated alluvial and lacustrine sediments deposited in ancient Lake Bonneville. The predominant soil series is the Playas-Saltair complex. The soil materials consists of stratified lacustrine silt, clay, and sand derived from several rock sources. The soil surface is covered with small rock pebbles on upland areas and moist clays with white salts on soils of the low-lying areas. The soil has accumulations of salt and sodium throughout the profile. Permeability is low and soils poorly drained. Some areas have been scarified mechanically near the new sewer treatment and lagoon system. Vegetative cover is sparse in the area resulting in bare soil surfaces over a significant portion of the area.

No hazardous or toxic compounds have been reported for soils of the area, with the exception of arsenic and beryllium, which may occur naturally in these soils. It is possible that unexploded ordnance may still exist in the area and the area would have to be cleared of such contaminants before the proposed action could be implemented. The naturally-occurring high concentrations of soluble salts in the soil would make landscaping with commercially available plants difficult if not impossible to grow. Importing topsoil may be necessary to provide a growing media for plants.

TOPOGRAPHY

Topography of the area is relatively flat with less than two percent slopes over most of the area. The landform is comprised of alluvial fans formed by erosion of the mountains to the north and west of the area. The general orientation or drainage of the area is from the northwest (elevation of 4,270 feet) to the southeast (elevation of about 4,220 feet). Because slopes are gentle there is little potential for erosion.

The ranges are comprised of Paleozoic sedimentary rocks, which include great thicknesses of carbonate rocks.

Six generalized stratigraphic units can be delineated within the study area within the upper fifty to sixty feet of the unconsolidated basin-fill sediments; three sandy silt to silty sand units and three clay layers which lie between the three silty sand to sandy silt units and beneath the lower silty sand to sandy silt unit. The five contacts between these six units lie at average depths of 4, 13, 19, 39 and 43 feet. The middle and lower sandy silt to silty sand units are saturated, but the uppermost unit is unsaturated.

Tungsten is the only mineral resource reported to occur in the Wendover area. Reilly Industries, Inc. uses ground water pumped from depths of between 300 to 500 feet to produce potash.

The environmental consequences of the Air Industrial Park and the co-compost unit for sewage sludge and municipal solid waste on the geology within the study area should be minimal if the operators of the facilities located in this area comply with all of the requisite state and federal regulations.

WILDLIFE

Wildlife on this site are very scarce because of the harsh habitat which includes salt-desert shrub habitat, lack of fresh water, high salt content of soils, intermittent water soaked soils and proximity to Wendover. Wildlife observed on the proposed site included the pocket gopher, antelope ground squirrel, black-tailed jackrabbit, side-blotched lizard, sagebrush lizard, western whiptail lizard, crows, and horned larks. No threatened or endangered species of wildlife are known from this area, and no serious impact to wildlife populations due to development of this area are anticipated.

METEOROLOGY

The Wendover area is marked by an arid continental climate with average annual precipitation of about 5 inches and average temperature of 52 degrees Fahrenheit. Annual precipitation ranges from 1.6 inches to 10.4 inches with the greatest daily precipitation of 1.95 inches. The highest daily snowfall was 5.5 inches. Daily temperature ranges from -18 degrees Fahrenheit to 105 degrees Fahrenheit with the average annual maximum temperature of 62 degree Fahrenheit and average annual minimum temperature of 42 degrees Fahrenheit. The average freeze-free period is 189 days. Winds are usually less than 5 miles per hour, however for brief periods gusts may reach 75 miles per hour.

SOCIOECONOMIC

Since 1986 the population of West Wendover City has increased from 1,500 to 3,000. The projected population by the year 2000 is 10,000. This population increase is based on two factors, an increased interest in gaming and tourism and development of the Air Industrial Park. The City Planning Commission and City Council have authorized construction of 1,606 new hotel rooms, which when allowing for new employees, will result in a population increase of 3,210. Based on the best estimates of employment as a result of the Air Industrial Park the population will increase an additional 3,790, giving a total population of 10,000 by the year 2000.

ARCHAEOLOGY (CULTURAL RESOURCES)

The archaeological survey of the proposed West Wendover Airport Industrial Park resulted in documentation of seven sites (one prehistoric lithic scatter, one extensive historic trash dump superimposed over a small prehistoric lithic scatter, three smaller historic trash dumps, and two small World War II wood and earth bunkers) and 13 isolated artifacts. Additionally, two previously recorded sites within the project area were relocated and it was determined that site records for these sites did not need to be updated. Of the nine archaeological sites that occur within the project area, four are considered potentially significant and must be studied further before either land modification or construction activities begin. Site CRNV-11-2833 should be mapped and surface collected and the apparent hearth should be excavated prior to development. Historic structures and associated features at sites CRNV-11-8631 and -8632 should be preserved in place and interpretive displays should be built along the stateline road immediately east of each site. Finally, representative samples of all time sensitive historic artifacts such as bottle finishes, bottle bases, and cartridge cases should be recovered from site CRNV-11-8633 prior to development of the study area.

1.0 PURPOSE OF AND NEED FOR ACTIONS

1.0 PURPOSE OF AND NEED FOR ACTIONS

1.1 INTRODUCTION

This section describes the purpose and need for the City of West Wendover, Nevada to annex 1,357.64 acres of land owned by the Department of Interior, Bureau of Land Management (BLM) and the U. S. Air Force to develop an Air Industrial Park and a facility for composting municipal solid waste and sewage sludge.

1.2 PURPOSE

The purpose of the proposed action is to assess the environmental conditions of the area under study to determine whether the land may be relinquished by the U. S. Air Force and the BLM for future industrial and commercial development.

1.3 NEED FOR ACTIONS

The City of West Wendover is "land locked." The area surrounding the city is owned by either the Department of Interior, BLM or Wendover, Utah. In addition much of the land within the city boundary is owned by the BLM and leased to the city on a long time basis. There is a need to acquire additional land for city expansion including an Air Industrial Park which would provide for growth of new business and industry thus supplying a much needed diversity in the city tax base. Figure 1, shows the strategic location of West Wendover City in providing an additional hub for air and highway commerce in the Intermountain Area.

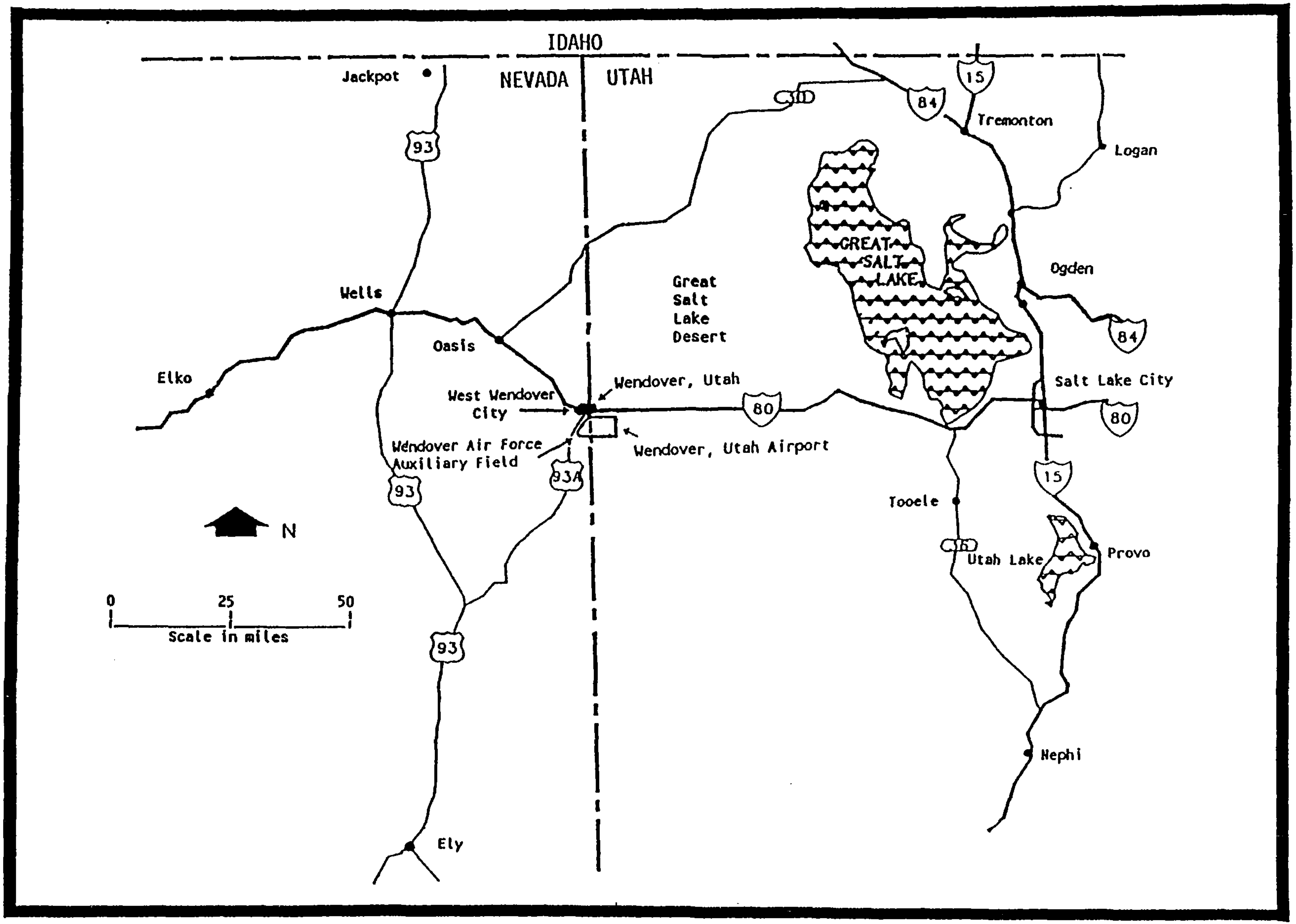


Figure 1. Map showing West Wendover City, Wendover Air Force Auxiliary Field, Wendover Airport and surrounding cities.

2.0 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

2.0 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

2.1 INTRODUCTION

This chapter describes the proposed action which would provide additional land for future growth of West Wendover City. Alternatives were not considered, as no action would leave the land in its present undeveloped state.

2.2 PROPOSED ACTION

For over a decade, community leaders have recognized the need to expand community borders. With new growth in West Wendover City, city leaders recognize the need to diversify business and industry beyond tourism, gaming and related businesses. In preparation for future development a new sewage treatment facility was completed in 1985 and plans are underway to recycle municipal waste by building a facility for composting sewage sludge and municipal solid waste. Another top priority is the development of an Air Industrial Park adjacent to the Wendover, Utah Airport. Figure 2, shows the land considered for relinquishment from the U. S. Air Force and BLM for development of these facilities. Appendix A gives a detailed account of additional actions accomplished since 1982 by the Town of Wendover, Elko County and the City of West Wendover, Nevada. (The City of West Wendover was incorporated in 1991.)

2.2.1 Air Industrial Park

In 1993 The City of West Wendover developed a Master Plan incorporating the proposed air industrial park within future city limits (Figure 3). Also in 1993 a proposed land use map was developed for an Air Industrial Park (Figure 4). Central in the industrial park plan is a landing corridor that extends west from the Wendover, Utah Airport to Nevada Highway 93A. In addition a proposed future railroad spur would connect the industrial park with the Union Pacific Railroad.

The Air Industrial Park is divided into three areas, 1. Air park, 880 acres, 2. Commercial area, 176 acres, and 3. Railroad park area, 410 acres. Thirty one different industries could be accommodated in the air park area. Nineteen spaces are planned for the railroad park and fourteen commercial business could be accommodated in the commercial area. Industrialist would have the option of shipping by air, railroad or highway. Interstate 80 and Nevada Highway 93A provide easy access to points throughout the Intermountain Area.

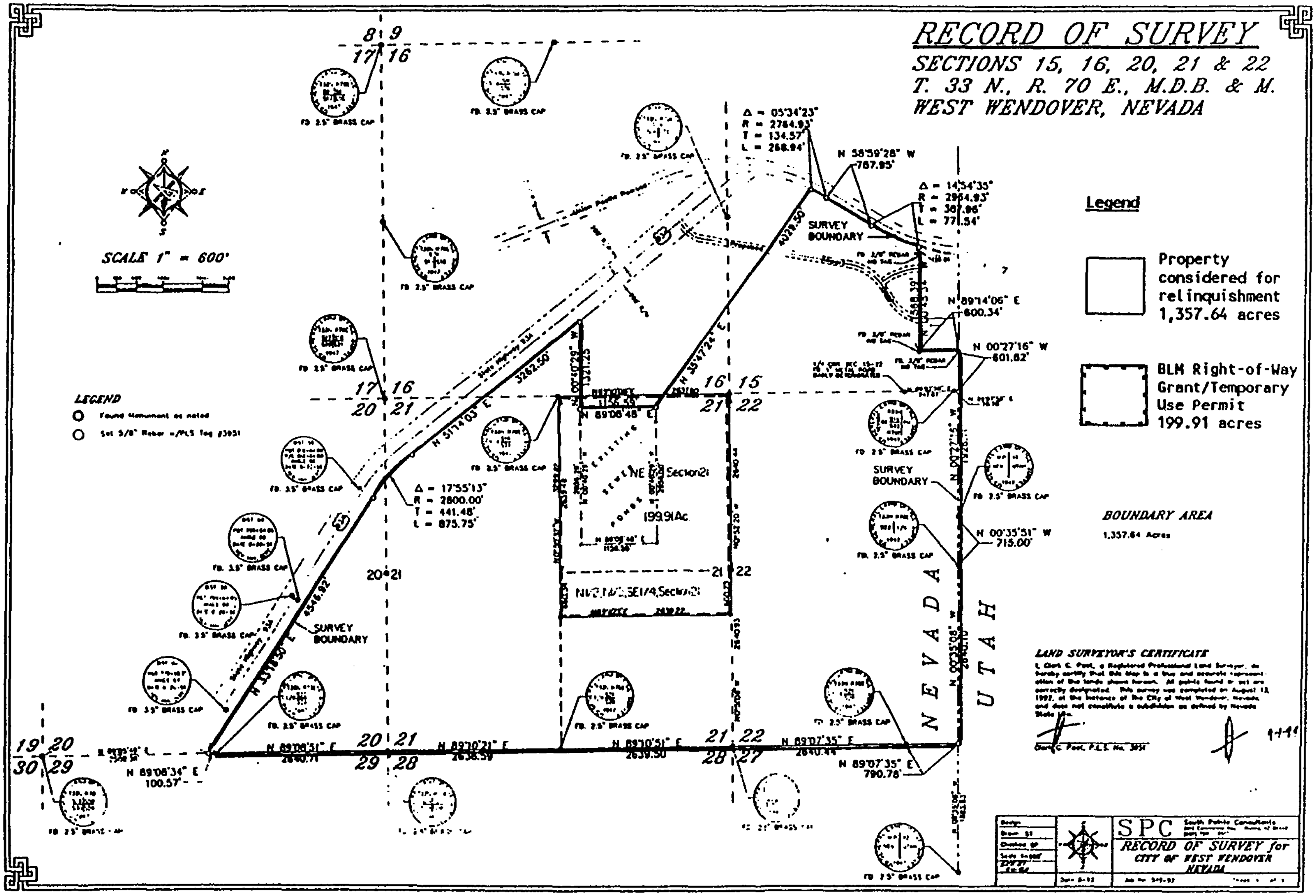


Figure 2. Map showing the boundary of the 1,357.64 acres considered for relinquishment by the U. S. Air Force and the Bureau of Land Management and the 199.91 acres granted in perpetuity to West Wendover City by the Bureau of Land Management in a Right-of-Way Grant/Temporary Use Permit.

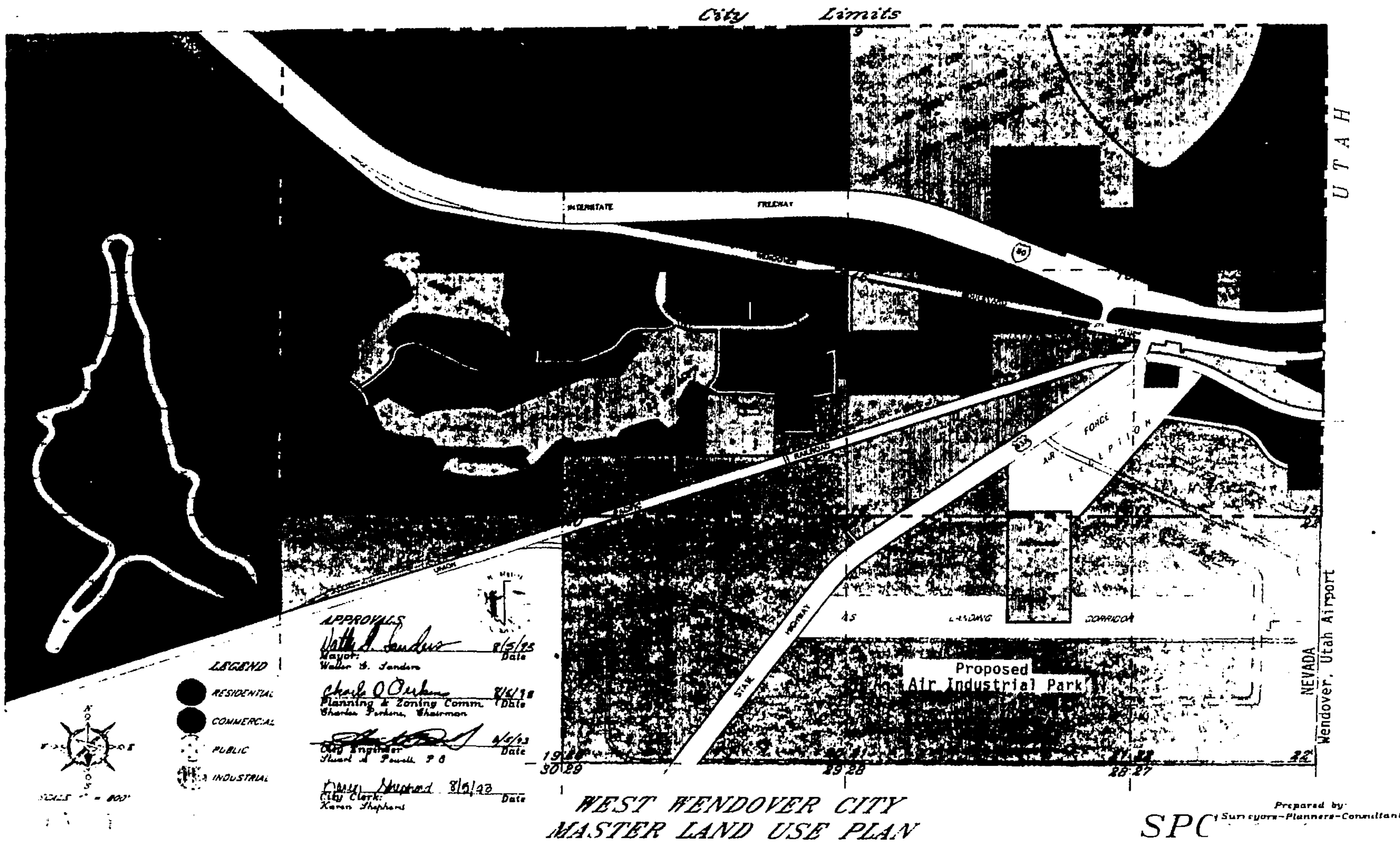


Figure 3. West Wendover City, Master Land Use Plan which incorporates the proposed Air Industrial Park within future city limits.

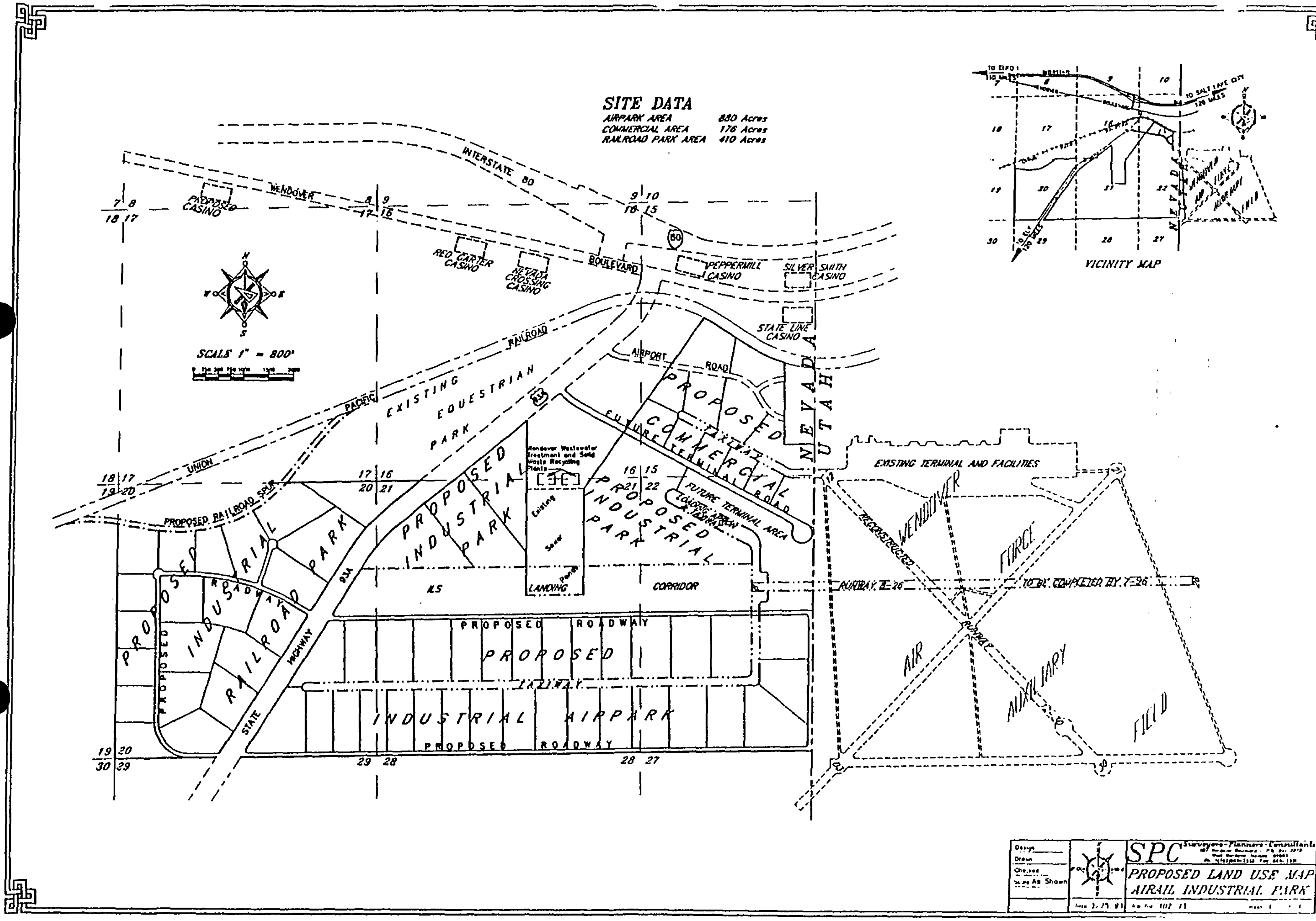


Figure 4. Proposed land use map of the Air Industrial Park. The park will be divided into three areas, 1. Airpark - 800 acres, 2. Commercial Park - 176 acres and 3. Future development of a Railroad Industrial Park - 410 acres.

2.2.2 Compost Facility for Sewage Sludge and Municipal Solid Waste (MSW).

The city needs space for disposal of MSW and sewage sludge. Unless other measures are taken the city will have to deal with this problem by joining with Elko County in developing a new landfill for disposal of its sewage sludge and MSW. The hauling distance to the new landfill would be approximately 100 miles.

In an effort to solve this important and pending problem, West Wendover City has developed plans to compost sewage sludge and MSW. The compost facility will be built as a unit, in one building, adjacent to the present sewage lagoon system. The new facility will handle the following operations on a daily basis:

a. Municipal solid waste will be sorted to remove all metal and plastic material,

b. Metal and plastic will be sorted for salvage and recycling,

c. Mixing of MSW and sewage sludge in a compost facility that will turn waste into top soil. The facility will control moisture content, temperature and supply of oxygen. With this process, topsoil can be created within a storage time of about one month.

d. The topsoil will be stored within the compost building and later sold to farmers, developers and other interested parties.

Land is needed for construction of the composting unit in the near vicinity of the newly developed West Wendover City sewage treatment facility and lagoon system.

2.2.3 Alternatives

Alternatives were not considered, as no action would leave the land in its present undeveloped state.

3.0 DESCRIPTION OF AFFECTED ENVIRONMENT

3.0 DESCRIPTION OF AFFECTED ENVIRONMENT

3.1 INTRODUCTION

This chapter deals with the existing environment in the 1,357.64 acres of land that is under consideration for relinquishment by the U. S. Air Force and the BLM. The following describes the environment in terms of soils, topography and vegetation, hydrology, geology, wildlife, meteorology and air quality, socioeconomics and archaeology.

3.2 SOILS, TOPOGRAPHY AND VEGETATION

3.2.1 Soils

The surface soils at the study area are characterized as basin fill deposits consisting mainly of non-inundated alluvial and lacustrine sediments deposited in the ancient Lake Bonneville (Radian Corporation 1993). The predominant soil series in the region is the Playas-Saltair complex (Trickler 1986). This soil unit is intricately intermingled with 60 percent Playas in the depressions and 30 percent Saltair silt loam on the slopes. The Playas-Saltair soils have low permeability, are poorly drained, and strongly saline. The soil materials consists of stratified lacustrine silt, clay, and sand derived from several rock sources and is on 0-1 percent slopes. This soil has accumulations of salt and sodium throughout the profile.

Soil pH is reported to average higher than 7.8, while soil salinity is greater than 16 mmhos/cm. Sodium absorption ratios range from 13 to 90 and cation exchange capacity ranges from 10 to 20 me/100g. These soil chemical and physical properties restrict the growth of most plants and also limit other land uses as well.

The subsurface soils consist of stratified lacustrine silt, clay, and sand. Six distinct units were identified in the subsurface to a depth of 67 feet using cone penetrometer testing technology (Radian Corporation 1993):

- **Upper Sand/Silt** (Average thickness 4 feet) light brownish gray to light gray, poorly graded, fine grained, dry to moist, firm to hard, friable.
- **Upper Clay** (Average thickness 9 feet) light gray to light olive gray, very soft to firm, silty, minor sandy seams, plastic, moist to wet, sticky.
- **Middle Sand/Silt** (Average thickness 6 feet) light gray to light olive gray, moist to wet, poorly graded, fine grained, loose, minor clay seams.
- **Middle Clay** (Average thickness 20 feet) light gray to light olive gray, wet, very soft to firm, silty, minor sandy seams, plastic, sticky.
- **Lower Sand/Silt** (Average thickness 4 feet) loose, wet, fine grained.

- **Lower Clay** (Average thickness greater than 24 feet) silty, firm to stiff, wet.

The eastern one-half of Section 21 (T. 33 N., R. 70 E., M.D.B. and M. West Wendover, Nevada) has been scarified by mechanical ripping to a depth of about two feet in preparation for development of a sewer treatment plant and lagoon system for the City of West Wendover, Nevada. This treatment has encouraged percolation of surface water, but has also reduced surface vegetative cover and has increased surface soil salinity due to thermal gradients resulting from bare soil which is warmer than underlying subsoils.

3.2.2 Topography and Vegetation

Topography of the area is relatively flat with less than 2 percent slopes over most of the area. The landform is comprised of alluvial fans formed by erosion of the mountains to the north and west of the area. The general orientation or drainage of the area is from the northwest (elevation of 4,270 feet) to the southeast (elevation of about 4,220 feet). A slightly elevated plateau occurs on the west side of the area and drops rather quickly (about 40 feet over a distance of about 2,640 feet) to the east where the elevational drop is about 10 feet over a distance of about 5,280 feet).

Vegetation of the study area is a salt-desert shrub type. The average annual precipitation is 6 to 12 inches, the mean annual air temperature is 45 to 52 degrees Fahrenheit, and the average freeze-free period is 120 to 160 days. Plant cover and species diversity are relatively low in this habitat type. The principal perennial species are iodine bush (*Allenrolfea occidentalis* - also called pickleweed), black greasewood (*Sarcobatus vermiculatus*), shadscale (*Atriplex confertifolia*), inland saltgrass (*Distichlis spicata*), and tamarisk or salt cedar. A few annual herbs such as halogeton (*Halogeton glomeratus*) and summer-cypress (*Kochia scoparia*) are also present along roadsides and other disturbed areas.

To the northwest side of the study area is a slightly elevated narrow strip of land (about 400 to 500 yards wide) adjacent to U.S. Highway Alt. 93. Soils on this elevated land are covered by small round pebbles (Figure 5), created by the erosional effects of water and wind. These pebbles form a stone mulch that is sometimes referred to as "desert pavement." The pebble surface reduces moisture loss by evaporation and also increases the soil surface temperatures due to the effects of solar irradiation warming the dark-colored pebbles. Soils in this area are well drained and lower in soluble salts than the soils at lower elevations. The higher elevations are predominated by shadscale with minor amounts of black greasewood.

The elevated land drops abruptly exposing lighter-colored, fine-textured soils that have relatively high salt contents. These intermediate elevations are vegetated with a mixture black greasewood and iodine bush (Figure 6). The black greasewood occurs in areas with lower soluble salts in the soil while the iodine bush occurs in areas

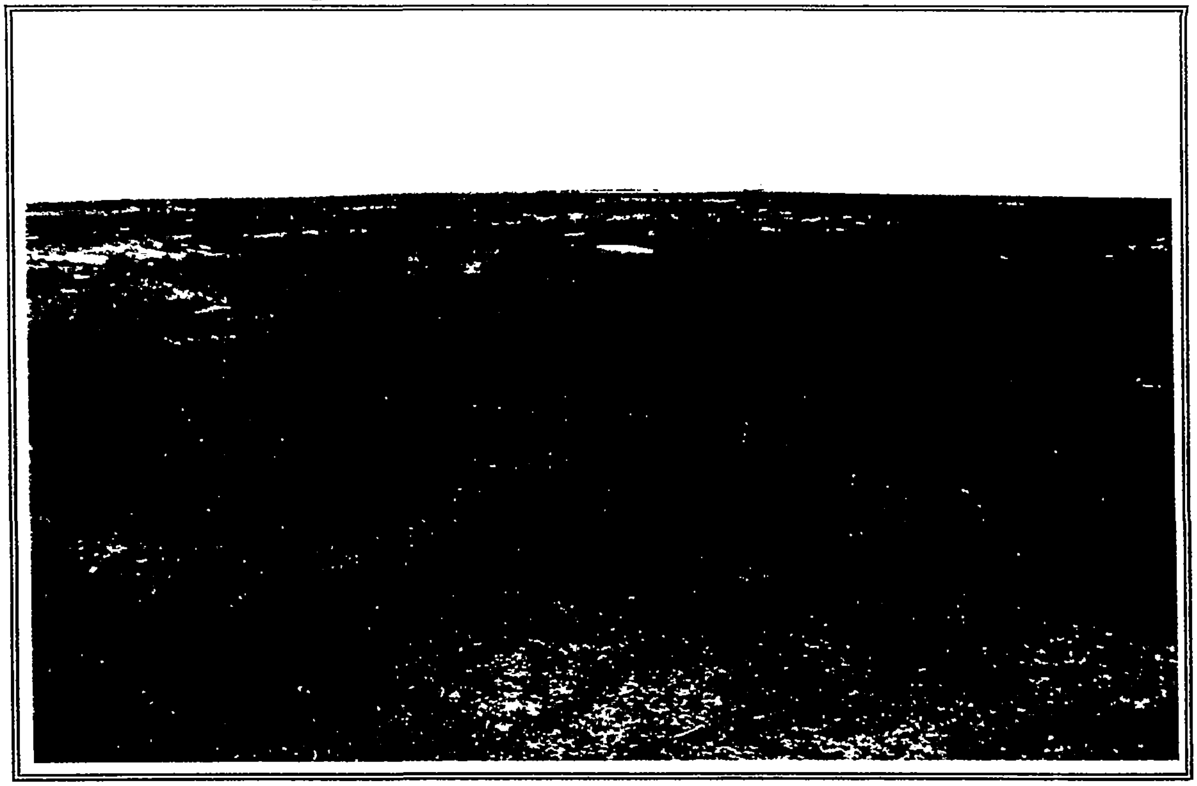


Figure 5. Shadscale desert shrub vegetation showing pebble mulch tween plants (looking southeast).

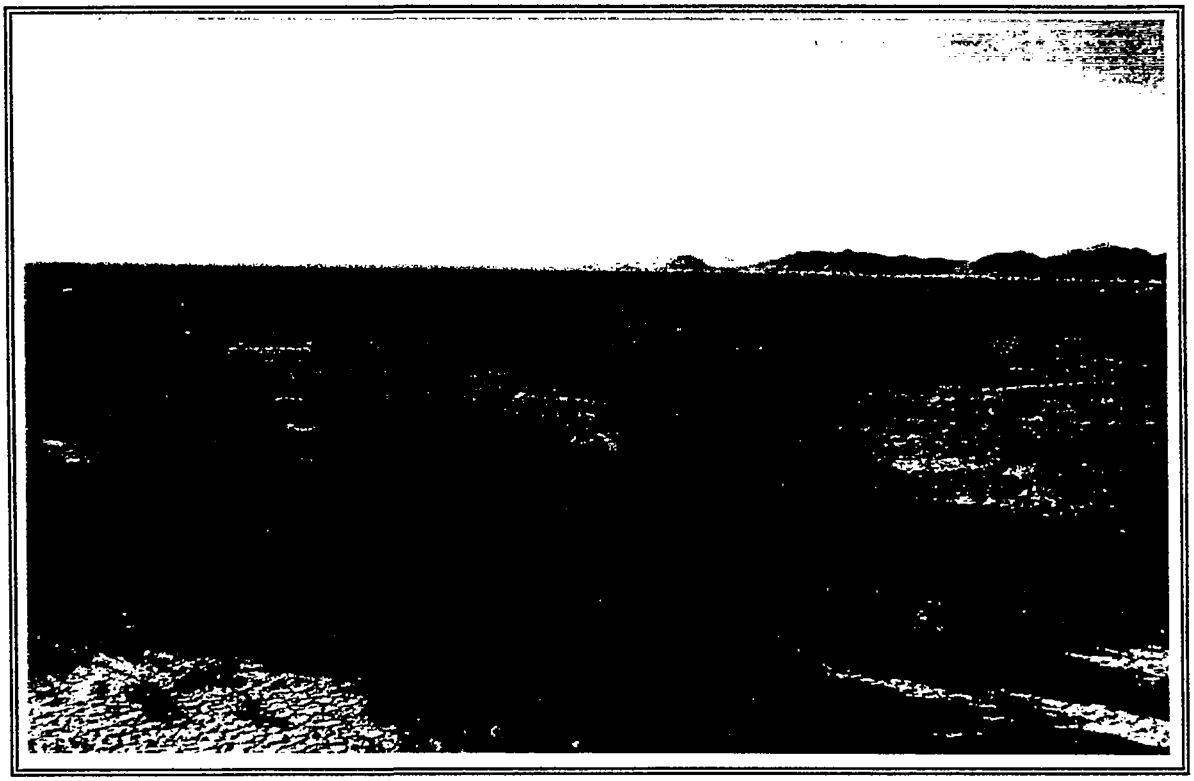


Figure 6. Black greasewood shrubs (looking south).

with higher soluble salts in the soil. The succulent nature of these plants allow them to conserve water during periods of the dry hot summer when soil moisture is reduced.

Soils located at the intermediate elevations are often variable. Both hills (soil mounds) (Figure 7), and gulleys Figure 8, are observed in this area. The hills are weathered from old alluvium and lacustrine sediments that contain high concentrations of salt. These low hills are relatively barren with little vegetation observed growing on them. Piping or erosion gullys and holes are also occasionally found in the intermediate elevations. No water was observed in the bottoms of these holes during the summer which indicates that the water table is not close to the soil surface in these areas. Well data taken in the summer of 1993 indicate that the water table is actually deeper than 25 feet in these areas.

The occurrence of inland saltgrass is restricted to the uplands in southeast corner of the study area (Figure 9), and along the man-made ditch and ceramic sewer pipeline leading to the old sewage treatment plant along the eastern edge of the study area (Figure 10). Soils within areas vegetated by inland saltgrass in the northeast corner of the study area are somewhat loose and relatively well drained. They have lower soluble salt concentrations than the other vegetated types. The burrowing activity of small mammals loosens the soil, aerates the rooting zone, and probably creates a rooting environment more conducive to the growth of inland saltgrass. The small mammals probably benefit from nutrients stored in the rhizomes of the inland saltgrass.

Iodine bush is the only species observed in the more saline lower elevations of the study area. These areas are generally more moist and more saline than other areas within the study area. The presence of high levels of sodium in the soil disperses soil particles and reduces soil permeability, thereby retaining water longer. Water is often observed ponded on these soils in the early spring and following summer storms. Once the plant becomes established, soil begins to accumulate around the base of the plant creating a hummock 1 to 2 feet in height. The soil salinity within this hummock are much lower than the surrounding playa and this lower salinity level is more conducive to plant growth. Iodine bush is one of the most salt-tolerant of plants found in the Intermountain Region. The lack of other plant species growing in an area characterized by iodine bush often indicates high soil salinity levels which are too high for other plant species to grow. One should not infer that other plants are restricted from growing in the area because of higher moisture levels in the soil.

The presence of tamarisk and inland saltgrass was observed in and around ditches (about 600 yards long) and the sewage lagoon (one-fourth acre in size) associated with the old sewage treatment facility, Figure 11, which was used earlier by the military base several decades ago. The man-made ditches, tiled pipes (Figure 10), and sewage lagoon (Figure 12), currently support the growth of these plant species. Tamarisk trees also grow between two raised soil areas (road bed and railroad bed) which catches and retains water following storms. Sewage water

Figure 7. Barren hills (soil mounds) formed by erosion of saline soil deposits. Because of the dry and salty soil little vegetation grows on these sites. Occasionally iodine bush grows on or around these hills.

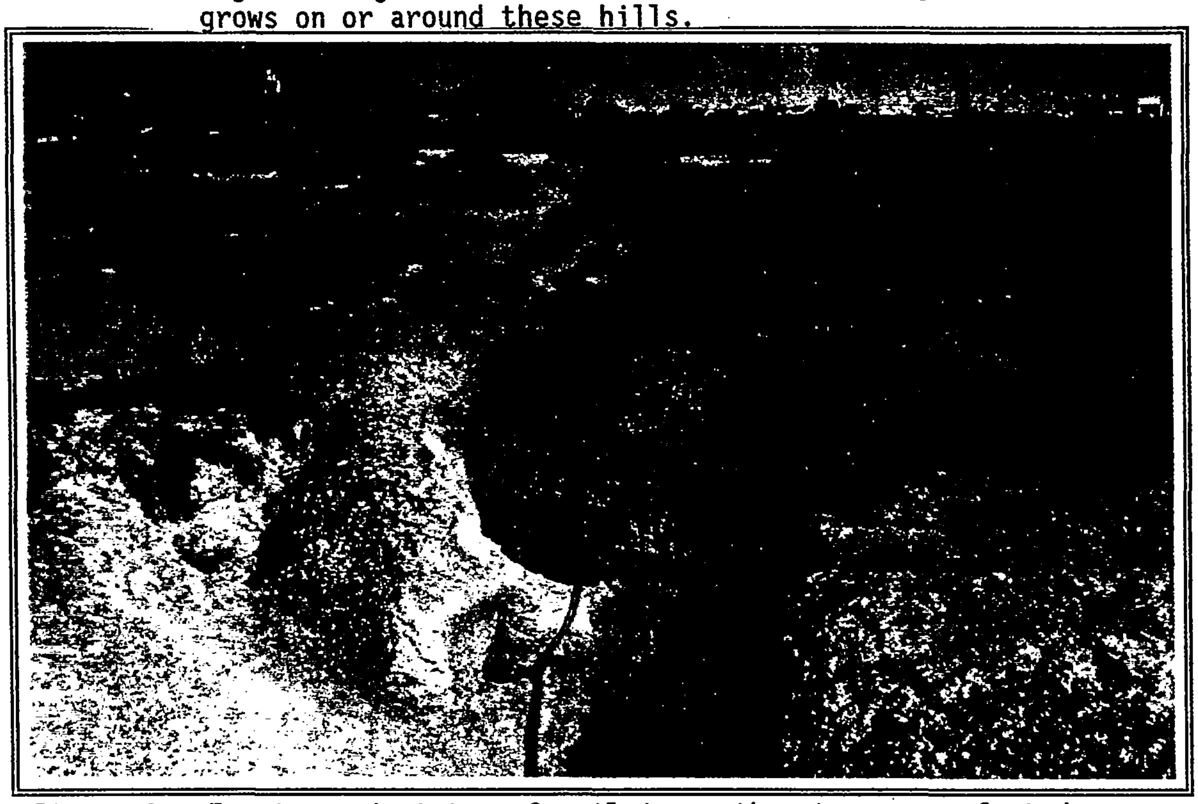


Figure 8. Erosion and piping of soil in northeast corner of study area (looking northeast). No water was observed in these 3 feet deep exposed holes indicating a deep water table. Wendover, Utah airport is seen in the background.

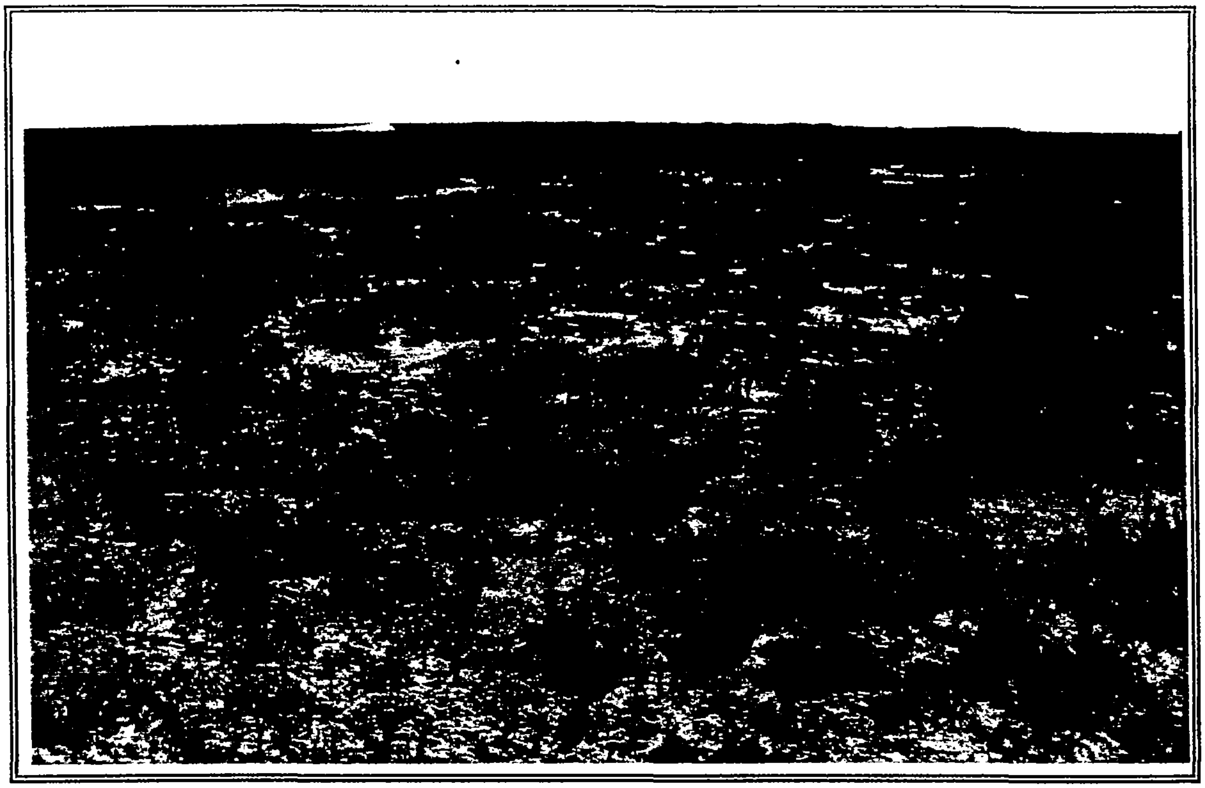


Figure 9. Inland saltgrass vegetation (looking southeast).

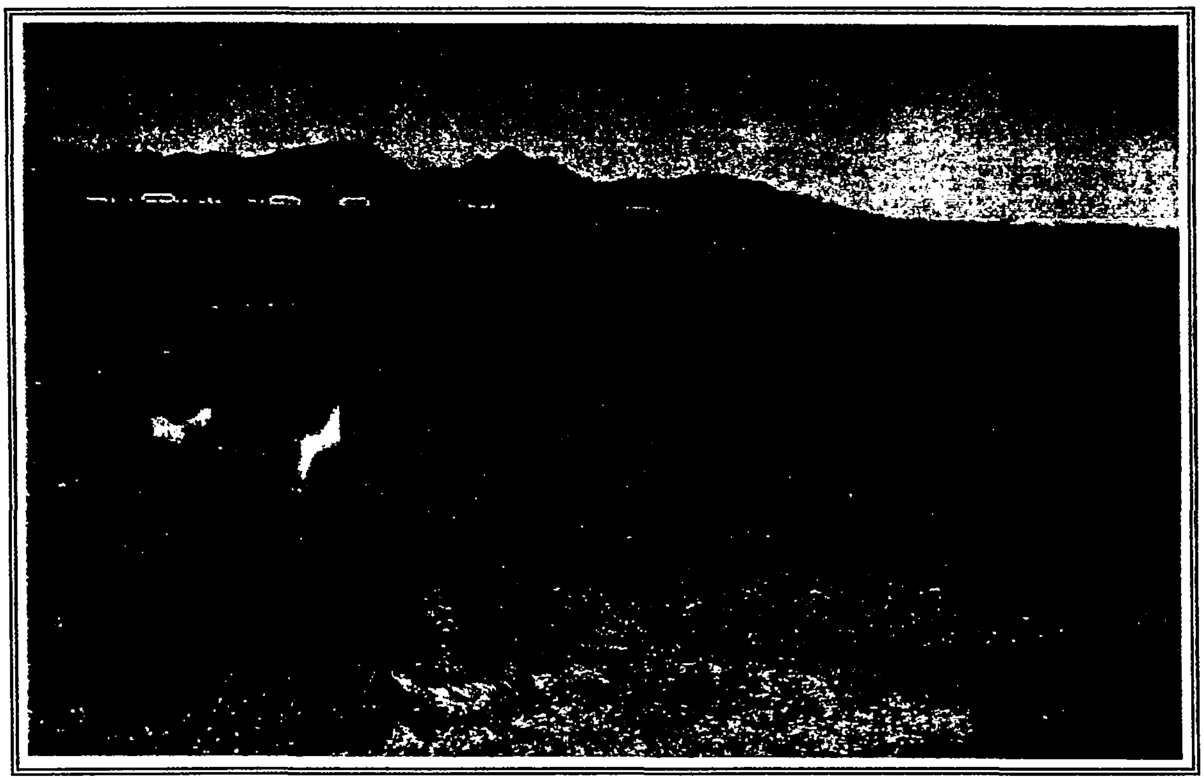


Figure 10. Iodine bush vegetation (looking northeast). Ceramic sewer pipeline is exposed near the surface.

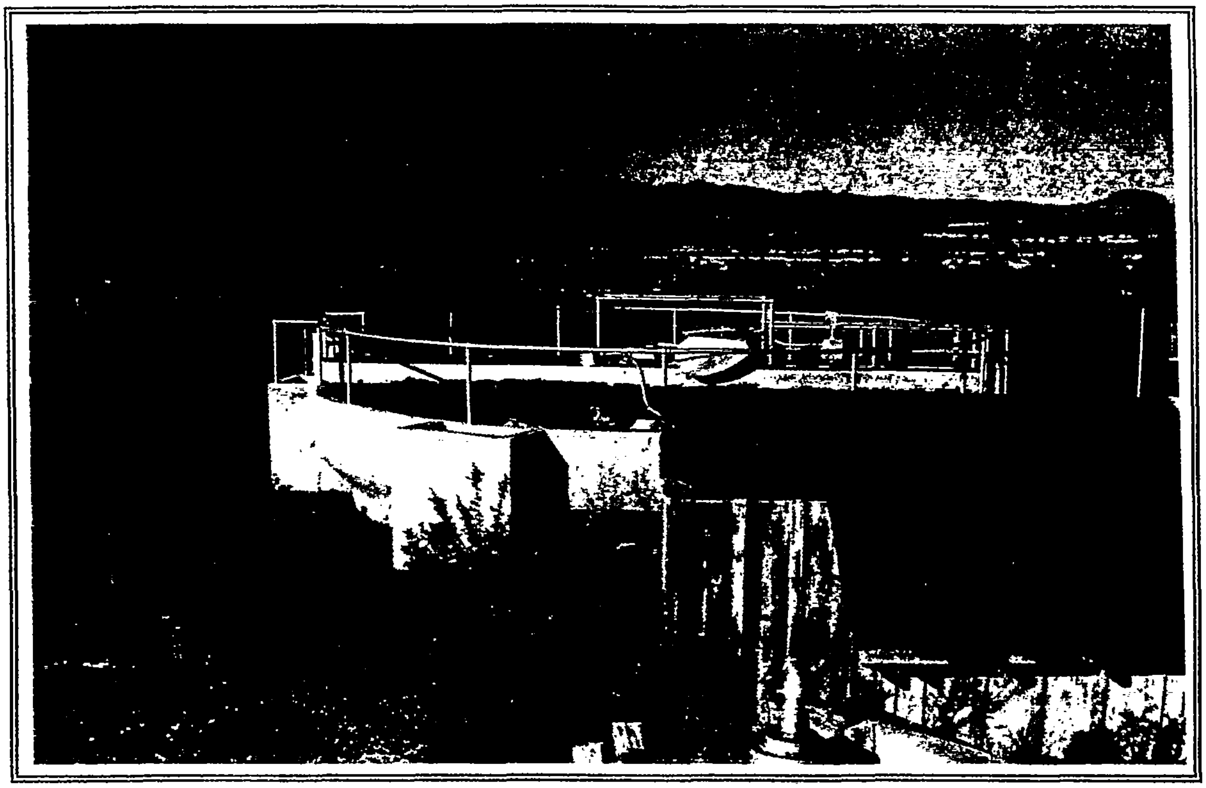


Figure 11. Old sewer treatment facility (looking southwest). Tamarisk trees and black greasewood plants grow around the facility.

Figure 12. One-fourth acre sewage lagoon or pond as seen from within (looking north). Saltmarsh bulrush is seen in the foreground and tamarisk trees in the background. This area continues to catch and retain runoff from surrounding areas and the old pipeline.

still flows, through this system in leaky pipes and is supplemented by storm runoff flowing overland in ditches. This water reduces the soluble salt concentrations of the soil and encourages growth of these plants. Saltmarsh bulrush (*Scirpus maritimus*) were also observed in the old sewage lagoon which is about one-fourth acre in size. The berms of the lagoon have been colonized by tamarisk.

The old sewage treatment facility is bordered by an old road and an old railroad bed which serves to collect and hold water during storm runoff (personal communication with fire fighters from the City of West Wendover, Nevada, October 24, 1994). The water from such storms has permitted the development of a narrow strip of tamarisk trees which grow taller the closer one approaches the facility where the water is deeper following storm events. Inland saltgrass is also commonly observed as understory plants. The vegetation in this areas appears to have developed in response to water harvesting created by the unique combination of the road and railroad bed and the sewage treatment facility.

An open sewage ditch (about 600 yards in length), with occasionally exposed drains and ceramic pipe also creates a narrow moist environment where tamarisk trees have colonized. Tamarisk trees were not observed in any other location within the study area.

The eastern one-half of Section 21 (T. 33 N., R. 70 E., M.D.B. and M. West Wendover, Nevada) has been scarified by mechanical ripping to a depth of about two feet. This treatment has reduced surface cover of vegetation, which is mostly iodine bush with small amounts of black greasewood, and has increased surface soil salinity. The increased soil salinity further lowers species diversity and biomass production.

Other disturbed areas include old sewage pipeline corridors, old roads, and access to the old military air field and runway. Most of these are currently devoid of vegetation, or sparsely vegetated. A few turnout roads, apparently used for military purposes, along the eastern boundary of the site have been graveled with a pea-size dark-colored rock. These areas were bordered with larger 4 to 6 inch rocks, apparently for decorative use. Little or no vegetation was observed in these graveled areas.

No threatened or endangered plant species were observed during a visit to the site in October, 1994, nor have any threatened or endangered plant species been reported to occur in this area or this habitat type within the State of Utah or Nevada (Personal communication with Ms. Janet Bair, Botanist for the U.S. Fish and Wildlife Service, Reno, Nevada Office. Note: a request has been made to Mr. David Harlow, Nevada State Supervisor for official clearance of the area for threatened and endangered plant and animal species and to have them provide a species list for all species concern.

3.3 HYDROLOGY

3.3.1 Surface Water

Due to the high evaporation rate in the area, surface water is present at the site only during short periods in the form of surface ponds. These periods occur mainly during the spring. The presence of surface water is related to occasional snow storms and spring snow melt. The water from the ponds infiltrates into the unconsolidated sediments.

3.3.2 Ground Water

The groundwater flows underneath the site in an unconfined aquifer. The aquifer consists of layers of sand and gravel, silty sand, and clay. The typical sequence of stratigraphic units is as follows: upper sand/silt (average thickness 4 feet), upper clay (9 feet), middle sand/silt (6 feet), middle clay (20 feet), lower sand/silt (4 feet), and lower clay (greater than 24 feet).

The groundwater flow direction in the area is strongly related to the surface topography. The site lies in a relatively flat fill basin and is surrounded by the following topographic features: to the north - Leppy Hills, relatively steep, sloping down to the south; to the west - Leppy Hills, mild slope, sloping down to the east; and to east and south - flat fill basin. The general slope of the terrain in this area is in the east-south-east direction.

The direction of groundwater flow is believed to be to the east toward the Great Salt Lake. However, the local groundwater flow direction, near the land disposal site, is to the south-west in the area north of the site. Underneath the site, the groundwater changes its flow direction to the south-east. The south-west direction of the groundwater flow north of the site is believed to be related to the topography of this area, namely the presence of Leppy Hills. As the groundwater flows towards the land disposal site, it encounters the groundwater flowing to the east from the hills located to the west of the site. The resulting groundwater flow direction is to the south-east. This discussion is based on the analysis of the groundwater table map prepared by Radian Corporation (Preliminary Assessment/Site Investigation Report, December 1993, Plate 3). It is noted that this map was prepared using data from two different groundwater table measurement events. The groundwater table in the monitoring wells was measured on November 2, 1993, whereas the groundwater elevation data measured using the cone penetrometer were obtained in June, 1993.

It is worthwhile mentioning that the sewage treatment lagoons, operated by the City of Wendover, seem to create a groundwater mound to the east of the lagoons. This is indicated by the elevated level of groundwater table in Well K-101.

Groundwater table elevation varies from zero to 35 feet below surface. The average depth to the water table is 1.5 to 8.0 feet. The approximate hydraulic gradient, estimated based on the groundwater table measurements, is I = 0.002 ft/ft. The average hydraulic conductivity is $K = 2.3\ 10^{-5}$ cm/sec. Assuming effective porosity n = 0.3, we can estimate the pore-water velocity to be

$$v = KI/n = 0.013 \text{ cm/day} - 0.16 \text{ ft/year}$$

The maximum pore-water velocity is estimated using the maximum measured value of hydraulic conductivity is K_{max} = 1.1 10-3 cm/sec, to be

$$v_{max} = K_{max}\ I/n = 0.634 \text{ cm/day} = 7.7 \text{ ft/year}.$$

It is apparent from these calculations that any contaminant movement in the subsurface will be quite slow.

3.4 GEOLOGY

The Wendover Air Force Auxiliary Field is located at the extreme northern end of the Bonneville region of the Basin and Range physiographic province. Physiographically, the region consists of linear, north-south trending mountain ranges separated by valleys, many of which are closed basins underlain by thick sequences of unconsolidated basin-fill sediments. The ranges are comprised of faulted Paleozoic sedimentary rocks, which include great thicknesses of carbonate rocks consisting of massive to thinly bedded limestones and dolomites with silty and sandy interbeds. The carbonate rocks range in age from Cambrian to Triassic, and are commonly intensively fractured or exhibit well-developed solution openings. The carbonate rocks range in thickness from about 500 to 25,000 feet (Bedinger, et al., 1990).

Extensive, unconsolidated to partly consolidated sediments form a veneer overlying the Paleozoic carbonate rocks within the region. These sediments consist of Quaternary and Tertiary lake and playa deposits, alluvial fans, colluvium and stream alluvium, and to a lesser extent landslides, beach ridges and sand dunes. These deposits consist primarily of poorly sorted to moderately sorted mixtures of fine-grained lake deposits and coarse to fine-grained sediments that were derived largely from the consolidated rocks in the nearby mountains. Materials in these deposits range from extremely large landslide blocks to coarse gravel and boulders near mountain fronts, to fine silt, clay and locally evaporite deposits on the valley floors and playas. The fill varies greatly both vertically and areally. The thickness of the Quaternary sediments is less than 300 feet for the most part, but thicknesses may approach 1,000 feet in a few areas. The total thickness of the upper Cenozoic sediments is as much as 9,000 feet in some areas (Bedinger, et al., 1990).

Within the study area, six generalized stratigraphic units can be delineated within the upper 50 to 60 feet of the unconsolidated basin-fill sediments based upon the logs for the twenty cone-penetrometer boreholes; three sandy silt to silty sand units and three clay layers. The uppermost layer is an unsaturated sandy silt to silty sand unit which extends from the ground surface to an average depth of four feet. The middle and lower sandy silt to silty sand units are saturated, and extend from average depths of 13 to 19 feet and 39 to 43 feet, respectively. The three clay layers lie between the three silty sand to sandy silt units and beneath the lower silty sand to sandy silt unit (Radian Corporation, 1993). The clay layers probably represent lake and/or playa deposits associated with Pleistocene Lake Bonneville or post-Bonneville high stands of the Great Salt Lake, and the silty sand to sandy silt units probably represent alluvial fan, colluvial and/or stream deposits formed during low stands of Lake Bonneville or the Great Salt Lake.

Tungsten is the only mineral resource reported to occur in the Wendover area (Smith, 1976), but little ore has been produced from this area to date. Reilly Industries, Inc., located immediately southeast of the Wendover Air Force Auxiliary Field, uses ground water pumped from wells drilled to depths from between 300 to 500 feet below ground level to produce potash (Radian Corporation, 1993).

3.5 WILDLIFE

The most current study relating to wildlife in the vicinity of the proposed project, is a Natural Resource Management Plan conducted for the Air Force. The following species <u>could possible be associated with the Utah Test and Training Range</u> (1,000,000 acres), although these species were not located on the Range (except for the peregrine falcon, bald eagle, long-billed curlew, white-faced ibis and Ferruginous hawk).

Threatened and endangered plant and animal species of northwestern Utah and northeastern Nevada:

Peregrine falcon	*Falco peregrinus*
Bald eagle	*Haliaeetus leucocephalus*
Least chub	*Iotichthys phlegethontis*
Bonneville cutthroat trout	*Salmo clarki Utah*
Compact catseye	*Cryptantha compacta*
Sand-loving buckwheat	*Eriogonum ammophilum*
Sunnyside green gentian	*Frasera gypsicola*
Frisco clover	*Trifolium andersonii friscanum*

Candidate plant and animal species of northwestern Utah and northeaster Nevada:

Spotted bat	*Euderma maculatum*
Bonneville pocket gopher	*Thomomys umbrinus bonneville*
Swasey Spring pocket gopher	*Thomomys umbrinus sevieri*
Skull Valley pocket gopher	*Thomomys umbrinus robustus*
Western snowy plover	*Charadrius alexandrinus nivosus*
Long-billed curlew	*Numenius americanus*

White-faced ibis	*Pleagadis chihi*
Ferruginous hawk	*Buteo regalis*
Utah physa snail	*Physella utahensus*
Currant milkvetch	*Astragalus uncialis*
Cow-plaster buckwheat	*Erigonum soredium*
Ostler peppergrass	*Lepidium ostleri*
Tunnel Springs beard-tongue	*Penstemon concinnus*
Spiranthes	*Spiranthes diluvialis*
House Range primrose	*Primula domensis*

Because of the topography, vegetation, no open water (except for a sewage lagoon), and proximity to Wendover, habitat for any of the above wildlife species does not exist. Birds listed above could potentially fly over the area, although habitat and food is virtually nonexistent.

In a survey of the site being considered in the environmental assessment, very little wildlife was apparent. This lack of wildlife is a reflection of the harsh habitat found in this salt-desert shrub habitat. Also, because of high salt content and intermittent water soaked soils, burrowing animals are virtually non-existent.

The exception to this would be the pocket gopher, and the antelope ground squirrel. The pocket gopher (*Thomomys bottae*) is found on the north part of the site where there is higher elevation and better drained soils. Also, the antelope ground squirrel (*Spermophilus leucurus*) is found in the north part of the area were thy burrow into the mounds of soil accumulated around the base of the pickleweed (*Allenrofea occidentalis*). The black-tailed jackrabbit (*Lepus californicus*) is also found on the proposed site. Mammals of this general area of the state include:

Big myotis bat	*Myotis lucifugus*
Hairy-winged myotis	*Myotis volans*
Small-footed myotis	*Myotis subulatus*
Silver-haired bat	*Lasionycteris noctivagans*
Big brown bat	*Eptesicus fuscus*
Hoary bat	*Lasiurus cinereus*
Black-tailed jackrabbit	*Lepus californicus*
Pygmy cottontail	*Sylvilagus idahoensis*
Mountain cottontail	*Sylvilagus nuttallii*
Townsend ground squirrel	*Spermophilus townsendii*
Antelope ground squirrel	*Spermophilus leucurus*
Gold-mantled ground squirrel	*Spermophilus lateralis*
Least chipmunk	*Eutamias minimus*
Botta pocket gopher	*Thomomys bottae*
Longtail pocket mouse	*Perognathus longimembris*
Great Basin pocket mouse	*Perognathus parvus*
Ord kangaroo rat	*Dipodomys ordii*
Chisel-toothed kangaroo rat	*Dipodomys microps*
Western harvest mouse	*Reithrodontomys megalotis*
Canyon mouse	*Peromyscus crinitus*
Deer mouse	*Peromyscus maniculatus*

Pinyon mouse	*Peromyscus truei*
Northern grasshopper mouse	*Onychomys leucogaster*
Desert woodrat	*Neotoma lepida*
Sagebrush vole	*Lagurus curtatus*
Long-tailed vole	*Microtus longicaudus*
Porcupine	*Erethizon dorsatum*
Coyote	*Canis latrans*
Gray fox	*Vulpes macrotis*
Ring-tailed cat	*Bassariscus astutus*
Long-tailed weasel	*Mustela frenata*
Badger	*Taxidea taxus*
Striped skunk	*Mephitis mephitis*
Spotted skunk	*Spilogale gracilis*
Bobcat	*Lynx rufus*
Antelope	*Antilocapra americana*

Because of the mobility of birds there are a great number of birds that may occasionally frequent the area. However, during the survey, only two species were observed on site. This included the american crow (*Corvus brachyrhynchos*), and the horned lark (*Eremophila alpestris*). The area within a few miles of the project site has the species listed below:

Turkey vulture	*Cathartes aura*
Bald eagle	*Haliaeetus leucocephalus*
Northern harrier	*Circus cyaneus*
Swainson's hawk	*Buteo swainsoni*
Red-tailed hawk	*Buteo jamaicensis*
Ferruginous hawk	*Buteo ragalis*
Rough-legged hawk	*Buteo lagopus*
Golden eagle	*Aquila chrysaetos*
American kestral	*Falco sparverious*
Peregrine falcon	*Falco peregrinus*
Prairie falcon	*Falco mexicanus*
Chukar	*Alectoris chukar*
Killdeer	*Charadrius vociferus*
California gull	*Larus californicus*
Franklin's gull	*Larus pipixcan*
Ring-billed gull	*Larus delawarensis*
Rock dove	*Columba livia*
Mourning dove	*Zenaida macroura*
Great horned owl	*Bubo virginianus*
Burrowing owl	*Athene cunicularia*
Long-eared owl	*Asio otus*
Short-eared owl	*Asio flammeus*
Common nighthawk	*Chordeiles minor*
Common poorwill	*Phalaenoptilus nuttallii*
Western kingbird	*Tyrannus verticalis*
Horned lark	*Eremophila alpestris*
Scrub jay	*Aphelocoma coerulescens*
Black-billed magpie	*Pica pica*
American crow	*Corvus brachyrhynchos*
Common raven	*Corvus corax*

American robin	*Turdus migratorius*
Sage thrasher	*Oreoscoptes montanus*
Northern shrike	*Lanius excubitor*
Loggerhead shrike	*Lanius ludovicianus*
European starling	*Sturnus vulagis*
Sage sparrow	*Amphispiza belli*
Boat-tailed grackle	*Cassidix mexicanus*
Brewer's blackbird	*Euphagus cyanocephalus*
House finch	*Carpodacus mexicanus*
House sparrow	*Passer domesticus*

The area in and around the project site has no known amphibians. However, the reptile species listed below are probably on or in the proximity of the project site. During the field survey the side-blotched lizard (*Uta stansburiana*), sagebrush lizard (*Sceloporus graciosus*), and western whiptail lizard (*Cnemidophorous tigris*) were observed. They were found in all of the habitats of the north and south part of the study area.

Short-horned lizard	*Phrynosoma douglassi*
Desert horned lizard	*Phrynosoma platyrhinos*
Side-blotched lizard	*Uta stansburiana*
Sagebrush lizard	*Sceloporus graciosus*
Western whiptail lizard	*Cnemidophorous tigris*
Striped whipsnake	*Masticophis taeniatus*
Great Basin gopher snake	*Pitouphis melanoleucus*
Wandering garter snake	*Thamnophis elegans*
Valley garter snake	*Thamnophis sirtalis*
Great Basin rattlesnake	*Crotalus viridis*

3.6 METEOROLOGY

The Wendover area is located on the Utah-Nevada State border at the western edge of the Bonneville Salt Flats at an elevation of 4240 feet msl, near 40.73 degrees North latitude and 114.03 degrees West Longitude. The Salt Flats are a remnant of subsidence of ancient Lake Bonneville and form the western edge of the Great Salt Lake Desert. This flat, desert plain, extends from Wendover east about 100 miles to the Great Salt Lake and Salt Lake City, about 50 miles north to the Grouse Creek and Raft River Mountains, and approximately 60 miles south to the Deep Creek and Fish Springs Ranges.

West of Wendover is the first of a series of north-south oriented mountain ranges found in eastern Nevada. These mountains are generally 8,000 to 9,000 feet above sea level with some peaks extending to 12,000 feet. About one-half mile north of Wendover is a low ridge, which rises to nearly 6,000 feet.

The mountain ranges to the west, particularly the Sierra Nevada Range, exert a marked influence on the climate of the region. Pacific storms, before reaching Wendover, must cross the massive Sierras and the other smaller ranges to the west of Utah. As the moist Pacific air is forced to rise over these mountains, a large portion of the moisture falls as precipitation. Thus, by the time the prevailing westerly air currents reach the Wendover area, they are comparatively dry, resulting in very light precipitation.

Wendover has an arid continental climate. This climate is marked by abundant sunshine, meager precipitation, low relative humidity, and large daily and annual ranges of temperature.

There are four well-defined seasons. Winters are cold but rarely severe since the Rocky Mountains to the north and east generally block invasions of extremely cold, continental air. Temperatures below zero are seldom recorded during the winter season. Snowfall is very light, averaging approximately eight inches annually, but over 15 inches have been reported in an unusual year. Due to the large amount of salt in the vicinity, the ground is greatly retarded from freezing, and snow usually melts rapidly, even though air temperature may be several degrees below freezing.

Summers are characterized by hot, dry weather. Maximum temperatures during the hottest months, July and August, are usually in the 90's; but the heat is not oppressive since the relative humidity is generally low. Temperatures 100 degrees Fahrenheit, or higher, occur occasionally in nearly every summer season.

Precipitation at Wendover averages about five inches annually and is rather evenly distributed throughout the year. Precipitation is slightly higher in the spring when storms from the Pacific Ocean are more intense than during the other seasons. In the late spring, summer, and early fall most of the precipitation occurs with thunderstorms. These storms produce moisture in widely varying amounts, and on rare occasions may bring more than one inch of precipitation in a few hours. At times Wendover receives no precipitation for a month or more.

The average freeze-free period is about 189 days and extends from mid-April to late October. However, due to the extremely light precipitation and the high salt content of the soil, there is little vegetation in the vicinity.

Winds are generally light in all seasons. This is due in part, to the protection afforded by the surrounding mountain ranges. In the northwest quadrant, however, a flat, broad canyon extends into the mountains and, after the passage of storms from that direction, strong, gusty winds are "funneled" toward Wendover. This canyon also funnels diurnal winds into the Wendover area. With the exception of these brief periods, when the gusts may reach 75 miles per hour, winds are usually less than five miles per hour.

Records of air quality at Wendover were not available for this report. The major degradation of air quality occurs naturally when high winds blow salt and soil particles into the atmosphere. Some degradation of air quality does occur at times for short durations in the vicinity of the potash plant, airport and individual locations. The expanse of the broad plain of the Great Salt Lake to the east, and light, diurnal mountain-valley winds are thought to keep the lower levels of the atmosphere in the vicinity of Wendover generally well mixed. Rarely, when the area is dominated by a High Pressure system and winds are light, inversions may occur and may decrease the air quality slightly.

Weather reports at Wendover began in 1911 when the station was located at the freight depot platform of the Western Pacific Railroad. In July of 1931, the station was moved to the Intermediate Landing Field about three-eights mile south of the post office. In December of 1942, the station moved to the U. S. Army Air Base, located one-half mile south-southwest of the post office. In March of 1950 the station was moved to the new CAA Office, one-half mile southeast of the post office. In September of 1959, the station was moved to the U. S. Air Force Auxiliary Field, Base Operations Building. For this report, the weather records from 1949 to the present for the different locations are considered compatible. Weather records for two years, from the two automatic reporting stations at Silver Island Pass and Bonneville Salt Flats were considered for this study because of their close proximity to Wendover.

3.7 SOCIOECONOMIC

Leaders in West Wendover City are developing a social and economic climate that is conducive to planned growth. Gaming and tourism are on the increase and plans are underway to diversify business and industry through the development of an Air Industrial Park. The city has experienced a steady increase in population since 1986 as the table below indicates.

Table 1. Population growth of West Wendover City between 1986 and 1994 and projected growth by the year 2000.

YEAR	POPULATION
1986	1,500
1987	1,750
1988	1,500
1989	2,000
1990	2,010
1991	2,030
1992	2,170
1993	2,550
1994	3,000
2000	10,000

The projected growth of 7,000 new residence by the year 2000 is based on two factors, increase in gaming and tourism and development of an Air Industrial Park. Hotel and motel operators are planning for expansion as shown in the table below.

Table 2. Number of hotel/motel rooms available in West Wendover City in 1991, 1994 and projected to 2000.

Total rooms	1991	1994	2000
Stateline	248	248	468
Silversmith	120	250	250
Peppermill	90	90	362
Nevada Crossing	130	137	137
Red Garter	0	46	46
Super 8 Motel	74	74	74
Proposed Casino	0	0	1195
Total rooms	**669**	**845**	**2451**

The city uses the projection of 1.5 employees per hotel room. With an increase of 1,606 hotel rooms over the next six years, 2,409 new jobs will be created. The average family size is 2.3 per household. Therefore if .58 percent of these new jobs are filled per family (in many households both spouses are employed) the projected increase in population based solely on the gaming and tourism industry is 3,214.

Population projections for an Air Industrial Park are more difficult to examine. However, based on interest expressed to city officials by industrialists, it is estimated that 2,845 new jobs will be developed, as a result of the new park, by the year 2000. Using the same equation as above, this would result in a projected population increase of 3,975 by 2000. This would equate to an increase of 3,210 residents from gaming and tourism and 3,795 as a result of the industrial park. The total population increase between 1994 and 2000 would be approximately 7,000.

3.8 ARCHAEOLOGY (CULTURAL RESOURCES)

3.8.1 Summary of Current Knowledge

Prior to the field investigation, a review of pertinent survey reports and site records was conducted at the Antiquities Section of the Utah Division of State History on May 23, 1994, and at the Elko District

Office of the Nevada Bureau of Land Management on May 26, 1994. Survey report data on file at the Utah Division of State History indicated that four archaeological surveys previously had been conducted within a three mile radius of the project area in Utah. Three of the above surveys resulted in negative findings and included the following projects: that portion of an intensive cultural resources inventory of the U. S. Telecom fiber optics cable route located along the Western Pacific Railroad tracks immediately south and east of Wendover, Utah (Billat et al. 1986); a survey of a proposed 500 acre military firing range north of Wendover (Russell 1986); and a linear survey of a proposed 1.4 mile long culinary water line just east of Wendover (Polk 1990). The most recent survey in Utah within three miles of the present project area was associated with the first year cultural resources inventory of the U. S. Air Force Utah Test and Training Range (Arkush et al. 1992). Part of this project resulted in formal recordation of the Deep Creek Railroad grade (site 42TO708), which occurs along the Utah-Nevada state line, and forms the eastern boundary of the study area.

Survey report data on file at the Nevada Bureau of Land Management's Elko District office indicated that eight surveys previously had been conducted within three miles of the project area in Nevada. Six of the surveys resulted in documentation of archaeological sites, two of which occurred within the present project area (Figure 13). The earliest of these two projects consisted of an unsystematic Class II type survey within relatively undisturbed portions of a 320 acre parcel containing the West Wendover sewage lagoons, most of which had been scarified by heavy military earth-moving equipment in order to locate unexploded ordnance, and was done without prior cultural resource clearance (Murphy 1984). Two prehistoric lithic scatters were identified during this project, one of which (CRNV-11-2833) occurs within the present study area and contains what appears to be an intact hearth feature (Figure 13). The other assessment previously conducted within the project area was a linear 1.1 mile long survey of the corridor associated with construction of Scobie Road (Johnson 1990). A heavily disturbed early twentieth century bottle dump (site CRNV-11-6094) was noted in the eastern portion of the survey corridor (Figure 13).

Three other nearby projects (Jerrems 1977; Janetski 1982; Billat et al. 1986) resulted in documentation of various historic sites, most of which consisted of trash dumps that were judged not significant. The final investigation mentioned here that resulted in positive findings was a Highway 93 Betterment Project that identified a small prehistoric lithic scatter just southwest of our study area (Miller 1985). Two linear surveys were conducted immediately north of the present project area and were associated with construction of a sewer line (Horne 1983) and an overhead transmission line (Marchio 1991). Both surveys resulted in negative findings.

The general area in and around the project property can be characterized as archaeologically sensitive, especially in regard to prehistoric sites. Numerous limestone caves and rockshelters occur in

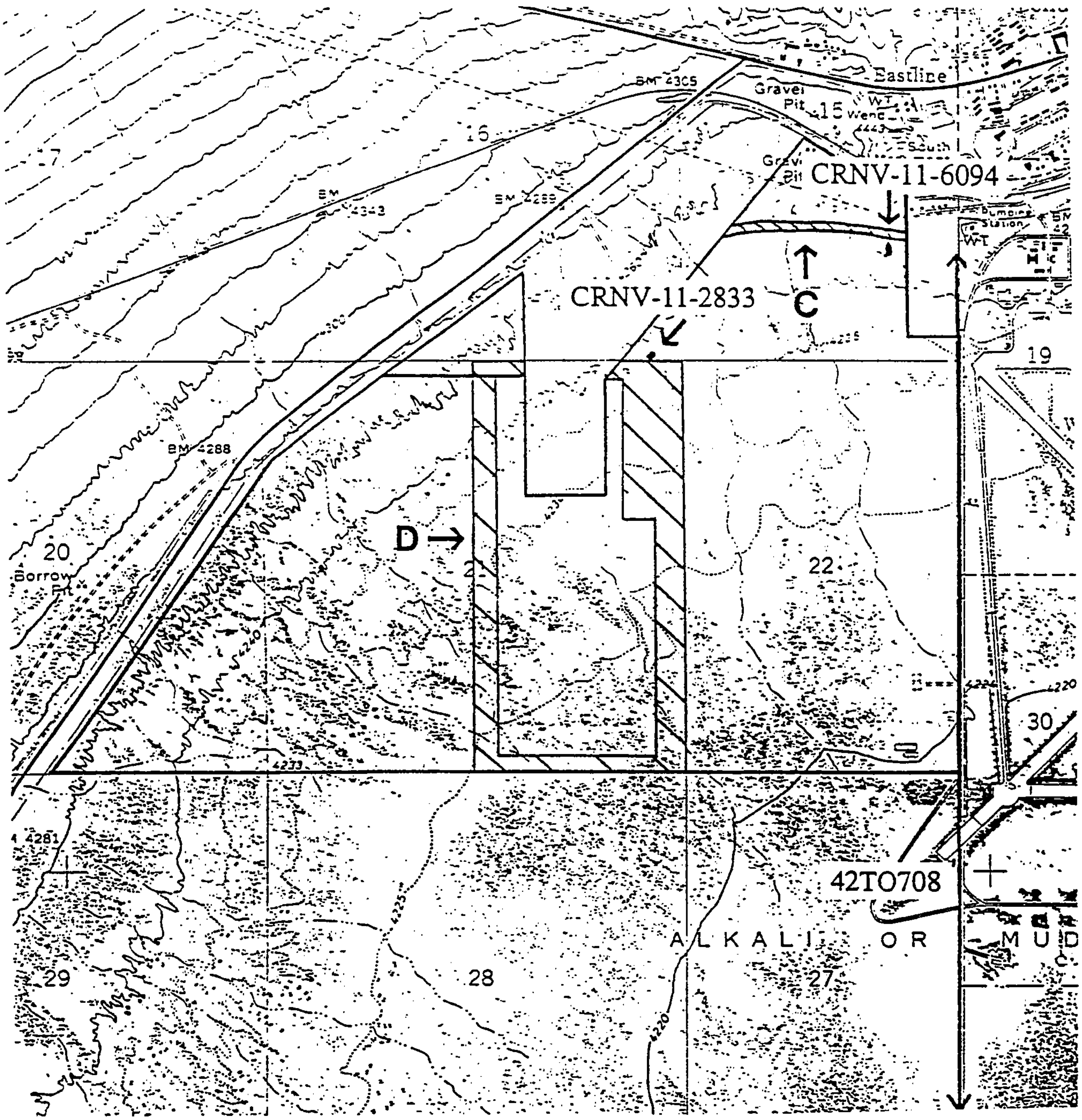


Figure 13. Map showing the locations of previous survey coverage within the study area (C refers to the Scobie Road Project and D refers to the West Wendover Sewage Lagoons Project), and previously documented archaeological sites 42TO708, CRNV-11-2833, and CRNV-11-6094. Adapted from the USGS Wendover, Nevada-Utah 7.5' series quadrangle.

the Leppy Hills immediately north of Wendover. These include Danger Cave (42TO13), Limestone Cave (42TO15), Jukebox Cave (42TO20), and others such as 42TO30, -507, -508, and -509. The east portion of the project area has a high potential for prehistoric sites because it coincides with the Gilbert Shoreline of Lake Bonneville, which dates to between approximately 10,500 and 10,000 years before present. (Benson et al. 1990). Previous work along the Gilbert Shoreline south and east of Wildcat Mountain on the Utah Test and Training Range has revealed the presence of Pinto sites that may date to the Early Archaic period when a semi-freshwater marsh probably existed in the area (Arkush and Workman 1992).

3.8.2 Cultural Setting

The cultural chronology of the study area can be reckoned in terms of prehistory and history. The vast majority of archaeological data concerning the prehistory of the Great Salt Lake Desert derive from intact, stratified cultural deposits recovered from dry cave sites such as Danger Cave and Hogup Cave, both of which were situated on the edge of Lake Bonneville, and were occupied by humans on an intermittent basis. Danger Cave yielded a record of seasonal human use spanning the greater part of the Holocene, from approximately 8300 B.C. until after A.D. 1400; Hogup Cave was occupied intermittently from 6350 B.C. to A.D. 1470 (Aikens and Madsen 1986).

Much of the cultural deposits at both Danger Cave and Hogup Cave consisted of the chaff of pickleweed (<u>Allenrolfea</u> <u>occidentalis</u>), a plant that produces a tiny seed. This plant resource was an important subsistence item for the various occupants of these two sites, and was especially important during the Wendover Period (ca. 7500 - 4000 B.C.). When combined, the cultural records from Danger Cave and Hogup Cave constitute the basis for the northeastern Great Basin cultural chronology (Jennings 1978).

Both Danger Cave and Juke Box Cave were first formally recorded in the late 1930s by Robert F. Heizer and Jack R. Rudy during their archaeological survey of portions of western Utah (Rudy 1953). Following its formal documentation, Danger Cave was test excavated by Elmer R. Smith (1942) during 1940 and 1941. This report contained a preliminary assessment of Danger Cave, and the cultural materials recovered by Smith were more fully reported by Jennings (1953).

Intensive excavation of Danger Cave commenced in 1950, following the University of Utah's 1949 investigations at Juke Box Cave, directed by Jesse D. Jennings (1957:47). Four field seasons were devoted to the excavation of Danger Cave, and the project essentially was complete at the end of the 1953 field season (Jennings 1957:50). Analysis of both natural and cultural materials recovered from the five major strata of Danger Cave yielded a record of intermittent human occupation spanning the greater portion of the Holocene Epoch (ca. 8300 B.C. - A.D. 1800) (Jennings 1957). Danger Cave functioned as a seasonal habitation site, and yielded an impressive assemblage of perishable and non-perishable artifacts, as well as the remains of plant and animal foods, and various cultural features (Aikens and Madsen 1986).

Investigations there resulted in the documentation of 13 feet of cultural deposits representing five separate periods of occupation. Over 1,000 complete and fractured millingstones were collected from the various strata, indicating the long-term importance of plant foods (especially that of pickleweed) in the aboriginal subsistence system of the region.

The fourth and perhaps final episode of archaeological research at Danger Cave was recently conducted by a team from the Utah State Antiquities Section led by David B. Madsen (1988). This investigation was part of the Silver Island Expedition, an archaeological research project concerned with increasing the data base concerning prehistoric human ecology in the Bonneville Basin. Three lake margin cave sites provided the majority of archaeological data for the project, one of which was Danger Cave, the remaining two being Floating Island Cave and Lakeside Cave.

The major goal of the Danger Cave project was to refine the stratigraphic sequence contained in the remaining dry cave deposits. In order to accomplish this, a 2 x 2 m. column of intact sediments near the southern part of the cave entrance was subjected to fine-grained excavation and analysis. Radiocarbon dating of singleleaf pinyon (Pinus monophylla) hull fragments recovered from the excavated column suggests that prehistoric hunter-gatherer groups had collected and consumed pinyon near Danger Cave since at least 7500 B.P. (Madsen and Rhode 1990). These data indicate that singleleaf pinyon was present in the northeastern Great Basin at least 2000 years earlier than previously thought, therefore requiring revision of current views concerning Holocene Great Basin plant biogeography. Additional analyses of the recently recovered stratigraphic column from Danger Cave include general botanical studies (Rhode 1988), faunal studies (Livingston 1988), lithic studies (Holmer 1988), and coprolite studies (Hall 1988).

Hogup Cave (formally recorded as archaeological site 42BO36) is a large stratified limestone cavern excavated by Aikens (1970), and found to contain 11-14 feet of cultural deposits, including 16 major strata occupied from 6350 B.C. to A.D. 1470. The extensive multiple living surfaces document repeated use of the site as a hunting and seed processing camp (Aikens and Madsen 1986).

3.8.3 Prehistoric Cultural Chronology

The prehistoric cultural chronology of the Great Salt Lake Desert region can be divided into five major periods: the Bonneville Period (9000 - 7500 B.C.); the Wendover Period (7500 - 4000 BC); the Black Rock Period (4000 B.C. - A.D. 500); the Fremont Period (A.D. 500 - 1300); and the Late Prehistoric Period (A.D. 1300 - 1850).

The Bonneville Period (9000 - 7500 B.C.) was probably characterized by small, highly mobile regional populations. Flaked stone tools best known from this period consist of fluted and stemmed thrusting spear points, which are often found in association with the shorelines of Pleistocene Lakes. This suggests that Bonneville Period peoples practiced a settlement system adapted primarily to lake and marsh ecosystems.

Subsistence seems to have centered upon the exploitation of seasonally available animal and plant foods. In the eastern Great Basin, the only excavated and dated cultural materials associated with the Bonneville Period come from Danger, Smith Creek, and Deer Creek caves (Aikens and Madsen 1986).

The Wendover Period (7500 - 4000 B.C.) is characterized by the occupation of many dry caves and rockshelters, and the replacement of the thrusting spear by the spear thrower (atlatl) and composite dart. Various types of side- and corner-notched dart points were first produced and used during this time. Coiled and twined baskets of various shapes also became common, as did the use of ground stone tools such as manos and metates.

In addition to harvesting and consuming pickleweed (Allenrolfea occidentalis) seeds, groups living in marsh settings also collected bulrush (Scirpus) and cattail (Typha) seeds. The remains of both large game and small animals are found in the faunal assemblages from Wendover Period sites and components. Rabbits and hares were especially important, and probably supplied the bulk of the day to day animal protein in many areas of the eastern Great Basin. The association of plant fiber nets in cave levels that contain large amounts of rabbit and hare bone suggests that Wendover Period groups conducted communal rabbit drives similar to those documented among Numic-speaking groups during ethnographic and historic times (Aikens and Madsen 1986).

There was an apparent increase in regional populations during the Black Rock Period (4000 B.C. - A.D. 500). Settlement patterns also became more diverse during this time, as groups began to occupy upland ecozones on a seasonal basis. This suggests that a somewhat drier and hotter climatic regime (i.e., the Altithermal) may have dominated the early portion of the Black Rock Period.

Pinyon pine was established in the eastern Great Basin by 4000 B.C., but there is little or no evidence that it was an important subsistence item at that time. It appears that pinyon exploitation in the region was not important until about A.D. 400 or 500. The bow and arrow replaced the atlatl and dart at the end of the Black Rock Period. This transition is marked by the appearance of small corner-notched projectile points, such as those of the Rose Spring and Eastgate series.

Presence of Fremont (A.D. 500 - 1300) cultures in the eastern Great Basin is an anomaly, as many of these groups were semi-sedentary village dwellers who raised a special variety of corn known as Fremont

Dent. Corn cobs of this type usually average 14 rows, display a tapered shape with wide bases, and have dented kernels. This variety of maize was drought resistant, adapted to climatic extremes, and a short growing season. In addition to Fremont Dent corn, these groups also cultivated several other varieties of the Southwest maize series (Marwitt 1986). Hunting and gathering was always important among the Fremont, especially in the northern (Uinta) and western (Great Salt Lake) portions of the Fremont region, where horticulture was a minor component of the subsistence economy.

Much of the Fremont phenomenon can probably be best understood as an indigenous local development with roots in the Desert Archaic Tradition, that resulted from interaction between eastern Great Basin native groups and those of the Southwest and Western Plains. This interaction probably consisted of the diffusion of both artifacts and ideas, as well as the actual migration of people. The Fremont Period marks the beginning of ceramic production in the eastern Great Basin.

The Late Prehistoric Period (A.D. 1300 - 1850) is marked by the abrupt replacement of the semi-sedentary horticultural Fremont culture by that of relatively mobile hunter-gatherer groups who possessed an archaic tool kit characterized by a wide variety of flaked stone implements. Most scholars interpret this phenomenon as the result of the expansion of Numic groups into the eastern Great Basin. Archaeological data from Hogup Cave and other sites in the eastern Great Basin support the proposition that the Fremont were replaced culturally and ethnically by Numic-speaking peoples (Marwitt 1986). Characteristic artifacts of this period include small side-notched and triangular Desert Series arrow points and unpainted brown and gray ware ceramics.

3.8.4 Ethnographic Data

During the ethnographic and historic periods, the region in and around the study area was occupied by the Gosiute Shoshone, a Western Shoshone group that occupied the Tooele, Skull, Rush, and Cedar valleys of northwestern Utah, and the Trout Creek and Deep Creek areas along the Utah-Nevada border. The Gosiute spoke one or more dialects of the Shoshone language of the Central Numic branch, which is part of the Uto-Aztecan linguistic family. Retention of traditional language among the Gosiute has been great, especially on the isolated Goshute Reservation in the Deep Creek area. The persistence of many other native practices into relatively recent times has contributed a great deal to our understanding of aboriginal Great Basin cultures.

Knowledge of Gosiute Shoshone culture derives largely from the work of Steward (1938, 1941). The typical independent economic and socio-political unit during most of the year consisted of the nuclear family cluster, which followed a series of seasonal movements in order to harvest available plant and animal foods. The greatest residential stability occurred in the winter, when villages of several family clusters were established in the lower portion of the pinyon-juniper woodland. This ecotone setting provided access to nearby caches of seeds and pine nuts, as well as firewood and water.

Plant foods probably formed the majority of the Gosiute diet (cf. Chamberlin 1911), and numerous tools aided in the collection, transportation, and preparation of seeds, roots, and pine nuts. These implements included twined seed beaters and burden baskets, digging sticks, pinyon poles and hooks, parching and winnowing trays, manos and metates, and coiled cooking baskets. The largest big game animal commonly encountered in the Gosiute home range probably was the pronghorn (Antilocapra americana), which was often the object of communal drives in which these animals were driven into wood, rock, and brush V-wing traps (Arkush 1986). Both ethnographic and archaeological data indicate that pronghorn drives usually occurred during fall, winter, and spring, when these animals tend to form large herds. During ethnographic times, such communal drives were preceded by a great deal of ceremonialism in which a shaman would "charm" a nearby herd for three to five nights in order to "capture" their souls and lure them into the trap.

It must be stressed that the capture of large game probably was not an everyday event. The vast majority of animal meat was provided by small mammals such as black-tailed hares, cottontail rabbits, pocket gophers, ground squirrels, prairie dogs, chipmunks, and woodrats. Reptiles and insects were also important food items among the Gosiute and Shoshone, providing additional sources of protein.

3.8.5 Early History

The Wendover area was periodically used for grazing purposes prior to the turn of this century, but the early history of the actual townsite (then known as Eastline) is best known from its association with the Western Pacific Railroad, which was incorporated in March of 1903 (Myrick 1962:316). This railroad traversed 924 miles between Oakland, California and Salt Lake City, Utah, and construction began at both ends of the line in 1906. Wendover first supported a substantial population after May, 1907, when railroad tracks had reached the Nevada-Utah state line (Myrick 1962:318). During its early existence, Eastline was used as a stock loading terminus while track construction continued between eastern Nevada and the California Bay Area. Regular freight service was first established over the entire system in December of 1909, and regular passenger service was instituted in August of 1910 (Myrick 1962:319).

3.8.6 Environmental Setting

The elevation of the study area ranges between 4220 ft. (1279 m.) and 4280 ft. (1297 m.) above sea level, and it occurs along the western edge of the Great Salt Lake Desert. Natural vegetation corresponds to the Great Basin Desertscrub plant community (also categorized as the

Northern Desert Shrub Biome) which in this region extends from approximately 4200 ft. (1273 m.) to 5000 ft. (1515 m.) above sea level. The plant community within the project area was dominated by halogeton (Halogeton glomeratus), black greasewood (Sarcobatus vermiculatus), and pickleweed (Allenrolfea occidentalis).

The animal community within the general project area includes black-tailed jackrabbit (Lepus californicus), desert cottontail (Sylvilagus auduboni), Townsend ground squirrel (Spermophilus townsendi), antelope ground squirrel (Ammospermophilus leucurus), kangaroo rats (Dipodomys spp.), coyote (Canis latrans), and mourning dove (Zenaida macroura).

The climate of the study areas is typically that of the Great Salt Lake Desert, with cold winters and hot, relatively dry summers. Temperatures in the Great Salt Lake Desert at times exceed 110 degrees F. Average rainfall throughout the study area seldom exceeds 10 in. (25 cm.) per year, with most of that falling in the winter months and during occasional summer thunderstorms.

The Great Salt Lake Desert consists of extensive areas of silt, mud, and sand, as well as two areas of permanent salt deposits outside of Wendover (Stokes 1986:255). Almost the entire playa area is saturated with water. Various bedrock outcrops surround the Great Salt Lake Desert, and the primary mountain ranges that rise above the western flatlands are the Silver Island Mountains, Pilot Range, Toana Range, Goshute Mountains, and Deep Creek Mountains.

3.8.7 Research Goals and Objectives

The objectives of an archaeological assessment are to locate, interpret, and evaluate the indications of past human activities in the study area. The indicators of such activities are labeled archaeological resources and can consist of any visible remains of human use of the environment. The locations of such resources can be defined by the presence of one or more of the following categories of archaeological remains: food waste, fragmentary or whole tools, tool manufacturing waste, modifications of natural rock surfaces, soil discoloration and/or its accumulation, or human skeletal remains. All such types of remains are known to exist in the general region. The scope of this study concerns cultural materials 50 years of age or older.

3.8.8 Survey Procedure

The field survey was conducted by Brooke Arkush and four crew members on May 28 and 29, 1994, and the entire project area was covered on foot by either east/west or north/south transects spaced 30 m. apart. Ground visibility within the study area varied from fair to excellent.

3.8.9 Survey Results

A total of seven archaeological sites were newly recorded during the course of the field investigation. These consisted of one prehistoric lithic scatter (#CRNV-11-8634), one extensive historic trash dump superimposed over a small prehistoric lithic scatter (#CRNV-11-8633), three smaller historic trash dumps (#CRNV-11-8619, -8630, and -8635), and two small wood and earth bunkers (#CRNV-11-8631 and -8632) apparently associated with World War II training activities at Wendover Air Field (Figure 14). Descriptions of the seven newly recorded sites are provided below.

Two previously recorded sites within the project area (#CRNV-11-2833 and -6094) were relocated during the course of the survey and it was determined that they were in the same condition as they had been when first recorded. Therefore, the site records for these sites were not updated. Various Anglo trash dumps younger than 40 years old were noted in the northeast portion of the project area and were not recorded. They apparently were deposited by various Wendover residents and none pre-date A.D. 1950. Additionally, 13 isolated artifacts were encountered during the course of the field investigation, Figure 15.

3.8.10 Archaeological Sites

CRNV-11-8619 (Wendover #1) - An historic trash deposit located in the northeastern part of the project area (Figure 14), dated between A.D. 1905 and 1945. The site measures 50 x 50 meters and consists of two distinct loci with a sparse scatter of debris in between the two areas. Associated artifacts include glass sherds, sanitary cans, ceramic dinnerware sherds, glass and shell buttons, leather boot fragments, and milled lumber. All bottle finishes there represent fully automatic bottle machine manufacture, and some amethyst sherds suggest an early phase of deposition slightly before about 1920.

The site no doubt is associated with early occupation of Wendover, but the site lacks integrity and has been adversely impacted by bottle collecting, as no complete bottles occur there. It will not contribute significantly to our understanding of regional history, and therefore is deemed not significant. The site has been properly documented and all important information it contains has been recovered. Therefore, it warrants no further consideration in management of cultural resources within the subject property.

CRNV-11-8630 (Wendover #2) - A relatively dense historic trash dump located in the northcentral portion of the study area (Figure 14), and dating between approximately 1910 and the early 1950s. The site consists of a linear scatter of debris measuring 70 x 130 meters, and contains five distinct loci of slightly different ages. Cultural materials there consist exclusively of fragmented glass and ceramic containers, and amethyst and "black" glass sherds indicate the site was first used for refuse disposal shortly after the turn of this century.

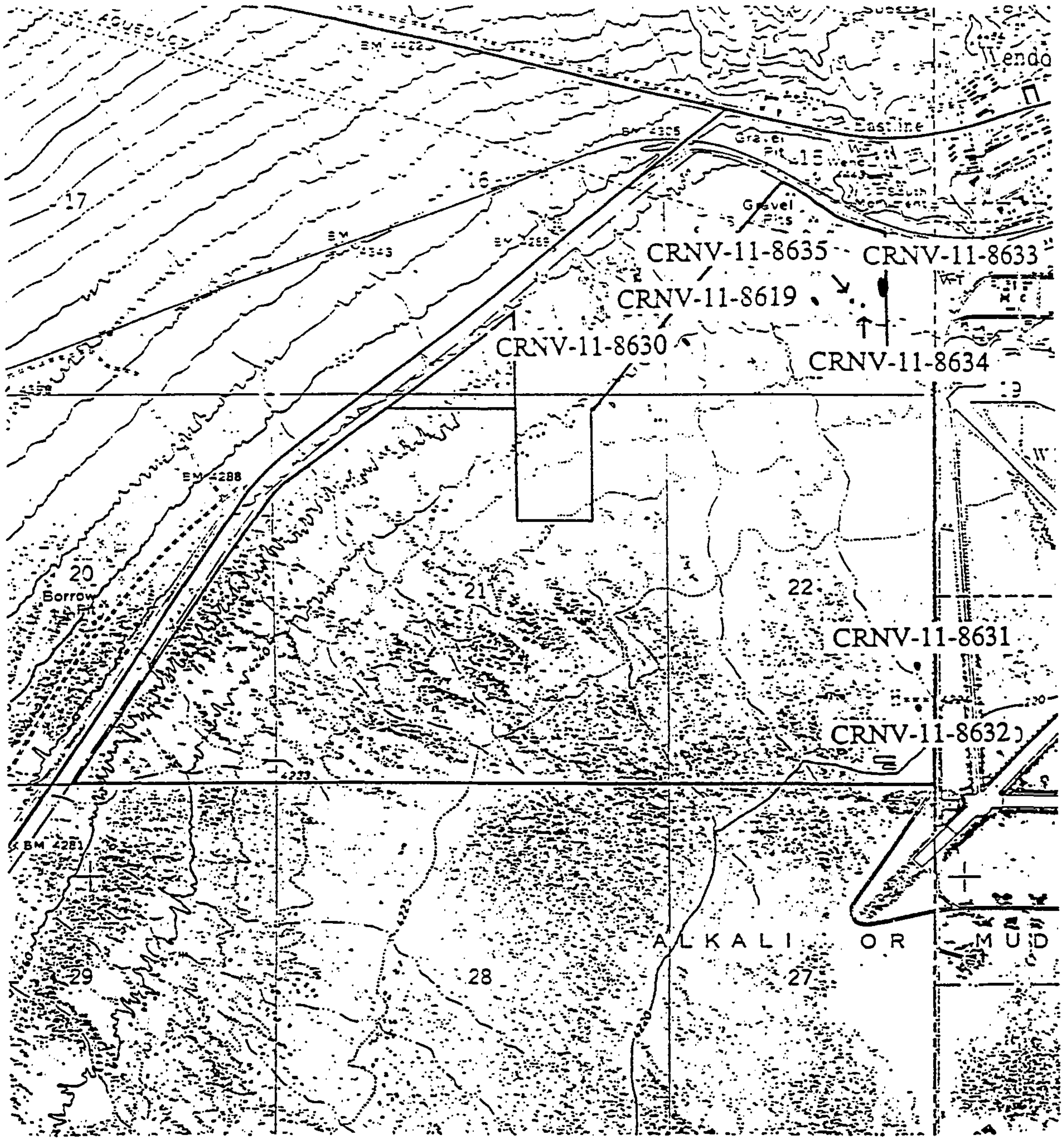


Figure 14. Map showing the locations of newly recorded archaeological sites within the project area. Adapted from the USGS Wendover, Nevada-Utah 7.5′ series quadrangle.

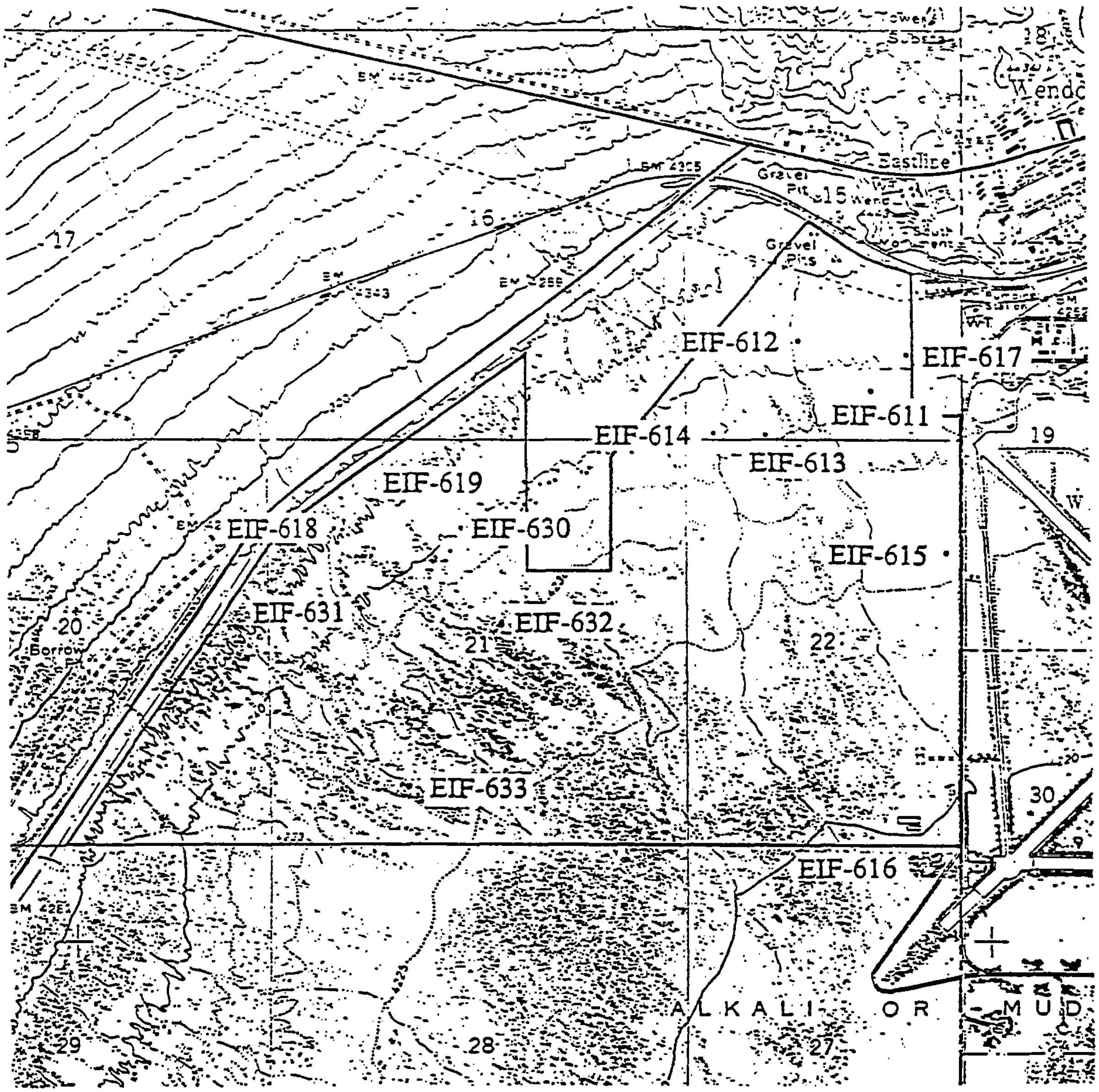


Figure 15. Map showing the locations of isolated artifacts within the project area. Adapted from the USGS Wendover, Nevada-Utah 7.5' series quadrangle.

The site has been disturbed by vehicular traffic, target shooting, and collecting, and is deemed not significant in terms of its integrity and ability to provide important information concerning regional history.

CRNV-11-8631 (Wendover #3) and CRNV-11-8632 (Wendover #4) - Two nearly identical earth covered wooden bunkers or "pill boxes" located in the southeastern portion of the survey area (Figure 14), and which probably date to the early-to-mid 1940s when World War II training at Wendover Air Field was at its height (Launius 1991). Each bunker measures 1.2 meters high, 2 meters deep, and 2.5 meters wide. Openings of both structures face due west, and they are constructed of wooden railroad ties that no doubt were scavenged from the old Deep Creek Railroad grade situated immediately east of the bunkers. The Deep Creek Railroad was primarily a subsidiary projection of the Western Pacific Railroad in Utah (Myrick 1962:337). It operated from 1917 to 1939 and was used primarily to haul copper, tungsten, and arsenic ore from the Deep Creek and Ferber mining districts around Gold Hill, Utah, to the Western Pacific Railroad division point at Wendover (Carr and Edwards 1989:130-132). Bunker roofs are covered with tar paper and earth, and each bunker blends into the surrounding environment in an inconspicuous fashion.

Two wooden plank boxes measuring approximately 0.5 x 5.0 meters occur 20 meters northwest and southwest of each bunker, and immediately east of each bunker is the remnants of some type of wooden ramp and an associated rectangular gravel pad. The reader should refer to the attached site record forms for illustrations and photographs of the bunkers and overall site configurations. One gets the impression that the bunkers functioned primarily as target practice facilities.

In his discussion of World War II training at Wendover Air Field, Launius (1991:338-339) mentions the use of a machine gun range built in a circular pit with a surrounding track around which a target travelled at a distance of between 170 and 240 yards away from the gunner's position, but he did not specifically mention the use of earth covered bunkers for machine gun practice. Additional archival and consultant research could easily identify the exact nature of training activities at the above two sites. Because both features are in good condition and exhibit structural integrity and are associated with important regional historic events, they are considered significant, and are worthy of future consideration in management of cultural resources located within the project area.

CRNV-11-8633 (Wendover #5) - An extensive historic trash scatter/small prehistoric lithic scatter located in the extreme northeastern portion of the project area (Figure 14). The prehistoric component consists of one locus (Locus 8) containing eight biface thinning flakes and one piece of core shatter, and three individual flakes scattered within the central and eastern parts of the site. The aboriginal component lacks time sensitive artifacts and therefore a relative time span cannot be assigned to it.

The historic trash deposit measures 65 x 90 meters, contains 10 distinct loci, and dates between approximately 1905 and 1945. Objects observed there include glass and ironstone ceramic sherds, cartridge cases, pull tab beer cans, sanitary cans, and metal barrel hoops. Some of the earlier bottles are represented by bases made by the Adolphus Busch Company between 1904 and 1907, and John Duncan & Sons during the same decade. The vast majority of bottles represent alcohol containers, and the bulk of site loci most likely derive from dumping of refuse from railroad workers' camps or perhaps taverns/bordellos that existed in Wendover during the first several decades of this century (Timothy Murphy, personal communication 1994).

Although the site has been impacted by illegal collecting and subsequent dumping of small amounts of modern trash, it is considered to be potentially significant in its ability to provide a representative sample of early twentieth century products that were consumed by some of the earliest historic occupants of Wendover. During this survey, an almost completely buried, intact bottle of Lea & Perrins Worcestershire Sauce was found at Locus 3. Therefore, it is quite likely that the site contains other complete early twentieth century bottles, and the site should be viewed as having the potential for providing additional information important in understanding the behavior of the early historic inhabitants of Wendover.

CRNV-11-8634 (Wendover #6) - A small prehistoric lithic scatter of unknown age located just southwest of site CRNV-11-8633, Figure 14, and measuring 25 x 25 meters. The site contains approximately 60 flakes of chert, ignimbrite, chalcedony, and obsidian and two obsidian biface fragments. Prehistoric cultural materials appear to be limited to the surface and the site has been disturbed by late historic period and modern refuse disposal and off road vehicles. Additionally, the site probably will not yield information important to our understanding of regional prehistory, and therefore is judged to be not significant.

CRNV-11-8635 (Wendover #7) - An historic trash deposit situated immediately west of site CRNV-11-8634 and immediately north of Airport Way, Figure 16, and which apparently dates to between 1905 and 1935. The site measures 25 x 60 meters, consists of six distinct concentrations of debris, and contains glass and ceramic sherds, and several metal automobile parts. The southern part of the site has been extensively disturbed by construction of Airport Way and off road vehicles have travelled over much of the site. It lacks integrity and will not provide critical new information to improve our understanding of regional history, especially that of early Wendover.

3.8.11 Archaeological Isolates

A total of 13 isolated artifacts (three historic and ten prehistoric) were documented during the course of the survey. Descriptive and locational data concerning these isolates are presented in Table 3, and their locations in relation to the project area are shown in Figure 15.

3.8.12 Assessment of Significance

For many years assessment of significance with respect to National Register criteria has been the means of determining which cultural resource sites contain information on the past that must be considered in environmental impact studies and the management plans of federal agencies. These guidelines apply specifically to all Bureau of Land Management lands in Nevada because all of these areas are administered by a federal government agency. The guidelines for assessing significance of cultural resource sites spell out with reference to specific criteria whether a given site is eligible for nomination to the National Register of Historic Places. Criteria of significance are set forth in 36 CFR 60.4. If sites meet certain criteria, they are judged significant, and thus are eligible for nomination for inclusion in the National Register. If they fail to meet the specified criteria, they are judged not significant and legally warrant no further consideration in matters of federal environmental review.

Criteria for evaluation are discussed in the National Register Criteria for Evaluation 36 CFR 60.4 (revised July 1, 1985):

> The quality of significance in American history, architecture, archeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association and
>
> (a) that are associated with events that have made a significant contribution to the broad patterns of our history; or
>
> (b) that are associated with the lives of persons significant in our past; or
>
> (c) that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
>
> (d) that have yielded, or may be likely to yield, information important in prehistory or history.

Table 3. Description and Location of Project Area Isolates.

ID #	DESCRIPTION	LEGAL
EIF-611	Red jasper biface thinning flake.	UTM Zone 11 749380 m E 4512570 m N SE 1/4 SE 1/4 SW 1/4 Sec. 15 T. 33N R. 70E
EIF-612	Amethyst bottle body sherd.	UTM Zone 11 749100 m E 4512750 m N NW 1/4 SE 1/4 SW 1/4 Sec. 15 T. 33N R. 70E
EIF-613	Ignimbrite core shatter fragment.	UTM Zone 11 749000 m E 4512370 m N SE 1/4 SW 1/4 SW 1/4 Sec. 15 T. 33N R. 70E
EIF-614	Ignimbrite biface thinning flake.	UTM Zone 11 748800 m E 4512360 m N SW 1/4 SW 1/4 SW 1/4 Sec. 15 T. 33N R. 70E
EIF-615	Amethyst bottle body sherd.	UTM Zone 11 749680 m E 4511920 m N NE 1/4 SE 1/4 NE 1/4 Sec. 22 T. 33N R. 70E
EIF-616	Ignimbrite biface thinning flake.	UTM Zone 11 749320 m E 4510780 m N SE 1/4 SW 1/4 SE 1/4 Sec. 22 T. 33N R. 70E

Table 3. Description and Location of Project Area Isolates (cont.).

ID #	DESCRIPTION	LEGAL
EIF-617	Aqua bottle base.	UTM Zone 11 749510 m E 4512700 m N NW 1/4 SW 1/4 SE 1/4 Sec. 15 T. 33N R. 70E
EIF-618	Ignimbrite biface thinning flake.	UTM Zone 11 747360 m E 4511920 m N SE 1/4 NW 1/4 NW 1/4 Sec. 21 T. 33N R. 70E
EIF-619	Ignimbrite medial biface fragment. Measures 0.5 cm thick, 2.5 cm wide, and 3.3 cm long.	UTM Zone 11 747450 m E 4512060 m N SW 1/4 NE 1/4 NW 1/4 Sec. 21 T. 33N R. 70 E
EIF-630	Ignimbrite biface thinning flake.	UTM Zone 11 747830 m E 4511930 m N SE 1/4 NE 1/4 NW 1/4 Sec. 21 T. 33N R. 70E
EIF-631	Obsidian biface thinning flake.	UTM Zone 11 747460 m E 4511630 m N SE 1/4 SW 1/4 NW 1/4 Sec. 21 T. 33N R. 70E
EIF-632	Ignimbrite biface thinning flake.	UTM Zone 11 747980 m E 4511600 m N SW 1/4 SW 1/4 NE 1/4 Sec. 21 T. 33N R. 70E

Table 3. Description and Location of Project Area Isolates (cont.).

ID #	DESCRIPTION	LEGAL
EIF-633	Ignimbrite medial biface fragment. Measures 0.4 cm thick, 2.1 cm wide, and 3.2 cm long.	UTM Zone 11 747640 m E 4510920 m N NW 1/4 SE 1/4 SW 1/4 Sec. 21 T. 33N R. 70E

The archaeological sites described above were evaluated with respect to these criteria. Of the seven newly recorded sites identified within the project area, three (CRNV-11-8631, -8632, and -8633) are judged to be potentially significant under Criterion D of the National Register Criteria for Evaluation, because they have yielded, or are likely to yield, information important to our understanding of regional history. Therefore, the above three archaeological sites can be considered as having the potential for nomination to the National Register of Historic Places.

4.0 ENVIRONMENTAL CONSEQUENCES OF PROPOSED ACTIONS

4.0 ENVIRONMENTAL CONSEQUENCES OF PROPOSED ACTIONS

4.1 INTRODUCTION

This chapter describes the direct cumulative impacts on the 1,357.64 acres of land under consideration for relinquishment by the U. S. Air Force and the BLM. The chapter also identifies mitigating measures, that must be accomplished, before the relinquishment may take place.

4.2 SOILS, TOPOGRAPHY AND VEGETATION

4.2.1 Soils

Because soils of the study area have high clay and silt contents that are also high in salts and relatively wet, especially in the winter and early spring, their suitability for a variety of uses is considered poor. The soils are rated as having "severe" problems for buildings and other site development based on wetness and flooding. Fill materials would have to be brought in to support foundations and other buildings. Landscaping with plants in soils around buildings would be adversely affected by the chemical and physical parameters of soils within the study area. Topsoil, of depths up to five feet, may have to be imported to support plants in landscaping around buildings and in other areas where landscaping is needed.

4.2.2 Hazardous Materials

No indications of any environmental contamination on the property were identified, either visually or through record search. HWS Consulting Group Inc., conducted visual survey of the property in December of 1992 and reported no findings of hazardous materials. Radian Corporation also investigated the present sewage treatment plant and lagoon system (built in 1985), adjacent to the property under investigation and reported that there were no PCB in or around the area under investigation.

Radian Corporation (1993) conducted analyses on soil gas samples to provide initial indications of the presence of volatile organic compounds (VOCs) in the subsurface. Soil samples were collected from above the water table during drilling from all boreholes, including those for monitor wells. Surface soil samples were also collected and analyzed for the entire Resource Conservation and Recovery Act (RCRA) target compound list/target analyte list (TCL/TAL). In additional, soil samples collected from monitor well boreholes were also analyzed for physical properties.

Results of soil analyses as reported by Radian Corporation (1993), only six contaminant compounds were detected in surface and subsurface soils at Wendover AFAF and most of these were located outside of the study area on the adjacent Wendover Air Force Auxiliary Field. Only arsenic and beryllium, inorganic constituents were detected in soils in concentrations exceeding the proposed action levels in 45 of the 46 locations sampled. Soils from the old sewage treatment lagoon measures 8.26 mg/kg for arsenic and 0.361 for beryllium. Soil tests in and around the landfill, initiated by Radian Corporation, showed levels of beryllium and arsenic at levels estimated to be normal for Eastern Nevada. Background levels of earth metals are normally high around saline bodies of water and in ground waters in arid areas. (For example, a lethal amount of arsenic is found in irrigation water used to irrigate farm land seventeen miles south of the property under investigation.)

Soils within the study area are comprised of clays, silts and other fine-textured soils. The ironically charged surfaces of these particles tend to retain heavy metals and other electrically charged molecules thereby, restricting their movement through the soil. These heavy soils serve to confine any materials that may have been released to the area. Over time, however, at least small amounts of these materials would have worked their way into the ground water. No petroleum wastes were detected in the area. Tests, to date, have not detected these contaminants suggesting that hazardous or toxic materials were either never released to the area, or if they were released have since biologically decomposed through natural processes.

There is a possibility of contaminants (unexploded ordnance, etc.) in the subsurface. A 100-foot right-of-way for Scobie Road and Airport Way was searched in 1990 with a Ferrous Ordnance Detector to a depth of 16 feet. No unexploded ordnance was found. The City of West Wendover received a Certificate of Clearance for the right-of-way, from the Department of Air Force, July 10, 1990, Appendix D. A paved road has now been developed between Nevada Highway 93A and the Utah-Nevada State Line. Furthermore, before any development could take place on the area under investigation, the area would need to be searched, to a depth of 10 feet, with a Ferrous Ordnance Detector as required by the BLM.

4.2.3 Topography and Vegetation

Under the Proposed Action, fill materials would be brought in and used to cover the existing soils and native vegetation of the study area would be buried or otherwise destroyed. The production of vegetation and species diversity within the study area is relatively low. This vegetation type is abundant in areas around the Great Salt Lake and other areas in Utah and Nevada where soils are saline and moist. Because of the low species diversity of this vegetation the impact would affect less than one dozen species. The eastern one-half of Section 21 has been scarified and already has very low cover and species diversity, the loss of vegetative resources in this scarified area would be less than in other non-scarified areas. Because the vegetative cover is so low in the study area, increases in erosion from wind and water would probably be minor.

4.2.4 Threatened and Endangered Plants

No threatened or endangered plants are reported to occur or were observed in the study area and consequently would not be affected by the Proposed Action.

4.2.5 Jurisdictional Wetlands

One concern about the Proposed Action on the vegetation is its possible impact to jurisdictional wetlands. To date no delineation of jurisdictional wetlands boundaries have been made at the study area, although field indicators for vegetation, soils and possibly hydrology indicate that some of the area may contain conditions which would place the land under the jurisdiction of the U.S. Army Corps of Engineers. A discussion of jurisdictional wetlands and field indicators present within the study area follows.

Jurisdictional wetlands are wetlands over which the U.S. Army Corps of Engineers takes jurisdiction for the purposes of protecting such resources through special regulations and permitting as part of the Federal Laws. All developments or impacts to jurisdictional wetlands and jurisdictional waters require a USACE permit under Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403) and Section 404 of the Clean Water Act (33 U.S.C. 1344). ENG Form 4345 (Aug 89) or a joint Federal-state application may be required. Instructions for completing the application are found in Publication United State Army Corps of Engineers Regulatory Program Applicant Information, EP 1145-2-1 May 1985.

There are a variety of formal wetland definitions. Several have been used by federal agencies. Among wetland definitions include those of the Food Security Act of 1985 (National Food Security Act Manual, USDA, 1988); the Emergency Wetlands Resources Act of 1988 (same definition); and the U.S. Fish and Wildlife Service definition used in the National Wetlands Inventory Program (Cowardin et al 1979). Four federal agencies have collaborated over a number of years to arrive at an "accepted" definition for use in their activities. This definition is most important because elements of the definition are used administratively by the U.S. Army Corps of Engineers for evaluation of wetlands. According to the Federal Manual (Environmental Laboratory 1987) a wetland can be defined as:

> *Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in*

therefore meets the second parameter that must exist for a wetland to be considered a jurisdictional wetland (Soil Conservation Service 1985). Some of the upland areas do not appear to be hydric soils, but a delineation of exact hydric soil boundaries has yet to be made within the study area.

The hydrology of the study area is the third parameter that must be present together with the other two before the area is considered to be a jurisdictional wetland. The term "wetland hydrology" encompasses all hydrologic characteristics of areas that are periodically inundated or have soils saturated to the surface at some time during the growing season. Areas with evident characteristics of wetland hydrology are those where the presence of water has an overriding influence on characteristics of vegetation and soils due to anaerobic and reducing conditions, respectively. Such characteristics are usually present in areas that are inundated or have soils that are saturated to the surface for sufficient duration to develop hydric soils and support vegetation typically adapted for life in periodically anaerobic soil conditions. Hydrology is often the least exact of the parameters, and indicators of wetland hydrology are sometimes difficult to find in the field. However, it is essential to establish that a wetland area is periodically inundated or has saturated soils during the growing season.

Observations of wells within the study area indicate that the depth to water table is in excess of 25 feet which would tend to argue against having wetland hydrology. These measurements were, however, taken in the summer of 1993 and may not be representative of conditions in the early spring when the water table is higher. Even with a lower water table, the surface soils are saturated during the early spring because of their high sodium and clay content and may meet the conditions that would classify the hydrology as "wetland hydrology." The hydrology will need to be investigated more thoroughly to determine its exact status over the site in light of field indicators for "wetland hydrology."

Personal communications with Ms. Jeanette Gallihugh, of the U.S. Corps of Engineer's Office in Reno, Nevada indicate that the Corps has taken jurisdiction of some areas dominated by iodine bush wetlands, particularly if the area has standing water in the spring and serves as habitat for bird, however, each site must be evaluated on a site-specific basis. It is apparent that more hydrologic data is needed to help clarify site conditions.

Implications of the Proposed Action on jurisdictional wetlands would be that a 404 Permit would be required before development of the study area could occur. All jurisdictional wetlands would have to be mitigated off site with equal or greater acreage as federal law mandates that there be "no net loss of wetlands." It is likely that wetland areas would be smaller than the total study area and may not occur within the study area at all. This decision would have to be rendered by the Corp upon review site conditions and available data.

saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas (EPA, 40 CFR 230.3 and CE, 33 CFR 328.3).

The Bureau of Land Management and the Air Force use this definition as set forth in the 1987 Federal Manual, because the classification of a jurisdictional wetland is based on these criteria. The use of the standard definition allows the Federal Agencies to be consistent with the U.S. Army Corps of Engineers, the key regulatory agency responsible for issuing permits for activities affecting jurisdictional wetlands.

"Jurisdictional wetlands" shall be defined as those seasonally or permanently wet areas that come under the domain or authority of the U.S. Army Corps of Engineers (USACE) for purposes of regulatory permitting on the basis of meeting wetland criteria as described in the 1987 Federal Manual.

According the 1987 Federal Manual, in order for an area to be considered a jurisdictional wetland it must meet certain technical criteria for wetland identification.

Technical criteria for wetland identification includes an evaluation of the following specific diagnostic environmental characteristics pertaining to vegetation, soils, and hydrology. In general, hydrophytic plants are typically adapted to saturated soil conditions and are able to grow, compete, reproduce, and/or persist in anaerobic soil conditions. Hydric soils are saturated, flooded, or ponded for a duration during the growing season sufficient to develop anaerobic conditions favoring hydrophytic vegetation growth. Areas exhibiting wetland hydrology are permanently or periodically inundated or have soil saturation within a major portion of the root zone during the growing season of the prevalent vegetation. Using the USACE three parameter approach for wetland identification, a minimum of one positive wetland indicator for *each* parameter (vegetation, soils, and hydrology) must be evident.

With the exceptions of shadscale (Facultative Upland - not hydrophytic) and black greasewood (Facultative Upland - not hydrophytic), the other major and predominant vegetation of the study area are considered to be hydrophytic vegetation (Reed 1988). Iodine bush is designated as a Facultative Wetland (FACW, or FACW+) species. Inland saltgrass is designated as a Facultative (FAC+*) and salt cedar is designated as a Facultative Wetland (FACW) species. These hydrophytic species contribute more than 50 percent of the vegetative cover over most of the study area, except the upland areas at higher elevations to the west of the study area. This conditions qualifies for one of the three parameters needed to characterize an area as a jurisdictional wetland.

Soils in the study area have been described as a Playa-Saltair complex. The Saltair soil series is considered a hydric soil and

4.3 HYDROLOGY

4.3.1 Surface Water Quality

Surface water in the area adjacent to the site does not occur in the form of permanent, natural streams or lakes. Occasionally, surface water occurs in the form of temporary shallow ponds, resulting from storm events and snow melt. Most of this water infiltrates into the unconsolidated sediments or evaporates before flowing onto lake bed sediments. Thus, any surface water contamination would occur during periods of flash flooding, and be caused by dissolution of constituents present in surficial soil into the aqueous phase. The transport distance of such contaminated surface water would be quite limited due its evaporation and infiltration.

4.3.2. Ground Water Quality

The natural groundwater quality of the shallow basin fill is characterized by high concentration levels of dissolved solids (500 - 200,00 mg/l). The principal constituents in the background groundwater are: calcium, magnesium, sodium bicarbonate, potassium, and chloride. The groundwater in the area is not used for drinking.

Potential contamination in the vicinity of the landfill could be related to the past disposal of metals, asbestos, volatile organic compounds, and petroleum hydrocarbons. It is also noted that most soil samples in this area are characterized by relatively high (above the proposed action levels) concentration of arsenic and beryllium. The proposed action levels are: 0.4 mg/kg for arsenic and 0.16 mg/kg for beryllium. The observed concentration levels of arsenic were in the range 1.5 to 5.9 mg/kg. The observed concentration levels of beryllium were above 0.3 mg/kg. One or more of the inorganic constituents were found in the groundwater samples at the site. However, these results are thought to be biased because the analytes was detected in the blank samples. In addition, we note that high concentrations of arsenic and beryllium were also measured in the background soil samples, indicating that these compounds naturally occur in the geologic environment.

Acetone was found at the site in the cone penetrometer (CPT) samples at the intermediate levels (0.1 to 0.5 ppm). Since the maximum concentration level for acetone is not established, it is difficult to evaluate the health and environmental impacts of the presence of arsenic in the CPT samples. It was observed that the highest concentration of acetone in the monitoring well samples, 11 ppb in Well K-104, was significantly lower than in the CPT samples, thus indicating limited influx of acetone into the saturated zone.

No organic compounds were found in the monitoring well samples above the maximum concentration levels. In particular, the concentration levels of benzene and toluene did not exceed 1 ppb.

In summary, the groundwater contamination at the site is minimal, and does not warrant any mitigation. The groundwater in the vicinity of the site is not used for drinking or as a resource (irrigation, livestock watering, commercial food preparation, aquaculture, or recreation). In addition, there are no wellhead protection zones in the area. Thus, there is no clear potential for exposure through the groundwater pathway.

4.4 GEOLOGY

Obviously, the environmental consequences of the Air Industrial Park will depend on the type of industries that end up locating there. Nevertheless, the environmental consequences of the park and the co-compost unit for sewage sludge and municipal solid waste on the geology within the study area should be minimal if the operators of the facilities located in this area comply with all of the requisite state and federal regulations.

4.5 WILDLIFE

There are several reasons that indicate that the proposed development would have little impact on the wildlife of this area. These reasons include:

1. The proximity to both the City of West Wendover, Nevada, and Wendover, Utah, preclude any real use of the project site by animals.

2. The proposed project site is a small part of a massive desert area, much of it with similar habitat and the same wildlife species. Therefore, any impact on wildlife populations because of the alternative use of the site will not affect wildlife populations.

3. The location for the proposed project site is a very bleak alkaline desert environment. Subsequently, habitat is available here for only a very small number ow wildlife.

Because of the above rational, the proposed project should not affect wildlife of this area in any significant way.

4.6 METEOROLOGY

The environmental consequence of the proposed action should be minimal if proper construction and landscaping is carried out during and after the development of the Air Industrial Park.

4.7 SOCIOECONOMIC

The Master Land Use Plan developed in 1993, by the City of West Wendover (page 11), illustrates sound planning for future commercial and industrial development. The land under investigation blends well into future city limits. City leaders recognize that mitigating measures must be taken before the area will be suited for development. The environmental consequence of the proposed action should be minimal, while at the same time enhancing the aesthetic and economic value of the area.

4.8 ARCHAEOLOGY (CULTURAL RESOURCES)

4.8.1 Management Recommendations

Of the nine archaeological sites that occur within the project area (two previously recorded and seven newly recorded), four are considered potentially significant and must be studied further before either land modification or construction activities commence within the proposed airport industrial park. No sites occur within the proposed municipal compost area, and development of this small parcel can begin at any time without endangering cultural resources.

Site CRNV-11-2833 is a small prehistoric lithic scatter with a possible hearth feature that was discovered by B.L.M. Elko District personnel in 1984, and is located in the northcentral portion of the study area, Figure 13. It is recommended that the entire site be mapped and surface collected and the apparent hearth be excavated prior to development of the parcel. This will ensure that any valuable information contained in the site will be recovered and properly analyzed before it is destroyed by development activities.

Sites CRNV-11-8631 and -8632 are historic military bunkers associated with World War II training activities at Wendover Air Field and located in the southeastern part of the project area, Figure 14. These structures and their associated outlying features should be preserved in place, and after further research has identified their exact function, interpretive displays should be built along the stateline road (the old Deep Creek Railroad grade) immediately east of each site to explain their role to future visitors. Information concerning the Deep Creek Railroad also could be incorporated into such a display. These measures would preserve the bunker complexes and also would serve as a valuable educational tool regarding the early history of the Wendover area.

Representative samples of all time sensitive historic artifacts such as bottle finishes, bottle bases, and cartridge cases should be recovered from site CRNV-11-8633 prior to development of the study area. This site is situated south of the Western Pacific Railroad tracks in the extreme northeastern portion of the project area, and is known to contain at least one intact turn of the century bottle. Site CRNV-11-8633 is by far the most important historic dump in the study area, and a program of systematic surface collection and perhaps archival research will preserve the critical data contained therein and help us understand the site's role in the early history of Wendover.

Sites CRNV-11-6094, -8619, -8630, -8634, and -8635 have been properly documented and have provided additional information to our overall understanding of regional prehistoric and historic cultural activities, and no further archaeological studies need be conducted at these locations.

If the above management recommendations are implemented, development of the Air Industrial Park will have no adverse impact upon the cultural resources located within its boundaries. Enactment of these recommendations also will result in increased public awareness of the importance and irreplaceable nature of cultural resources as well as enhancing our understanding of prehistoric and historic activities in the Wendover area. All site specific data (such as information regarding site locations) contained in this report is considered confidential, and should only be made available to key project personnel on a need-to-know basis. Site specific data discussed and shown herein must be omitted from any public document associated with the proposed industrial park.

5.0 PREPARERS OF ENVIRONMENTAL ASSESSMENT

5.0 PREPARERS OF ENVIRONMENTAL ASSESSMENT

The preparers of this Environmental Assessment are from a broad background of experience including consultants from the Applied Ecological Services, Inc., Weber State University and Utah State University.

Soils, Topography and Vegetation

Dennis Hansen, Ph.D., President, Applied Ecological Services, Inc., Adjunct Professor, Botany Department, Weber State University.

Hydrology

Marian W. Kemblowski, Ph.D., Associate Professor, Utah Water Research Laboratory, Utah State University.

Geology

Thomas E. Lachmar, Ph.D., Associate Professor, Geology Department, Utah State University.

Wildlife

Gar W. Workman, Ph.D., Vice President, Applied Ecological Services, Inc., Associate Professor Emeritus, Fish and Wildlife Department, Utah State University.

Meteorology and Air Quality

Donald T. Jensen, Ph.D., Director, Utah Climate Center and State Climatologist, Associate Professor, Plants, Soils and Biometeorology Department, Utah State University.

Socioeconomic and Project Coordinator

Wesley T. Maughan Ph.D., Professor Emeritus, Sociology and Community Development, Utah State University and Senior Scientist, Applied Ecological Services, Inc.

Archaeology (Cultural Resources)

Brooke S. Arkush, Ph.D., Assistant Professor, Anthropology Department, Weber State University.

6.0 ORGANIZATIONS AND PEOPLE TO WHICH COPIES WERE SENT

6.0 ORGANIZATIONS AND PEOPLE TO WHICH COPIES WERE SENT

One copy of the Environmental Assessment was sent to the City of West Wendover, Nevada, and one copy was sent to the Division of Environmental Protection, Carson City, Nevada.

Copies of the Environmental Assessment will be sent to the following organizations after it has been approved by the U. S. Air Force.

Wendover City, Utah

U. S. Air Force, Hill Field, Utah

Bureau of Land Management, Elko District, Nevada

Department of Conservation and Natural Resources, Division of Environmental Protection, Carson City, Nevada.

Elko County Commissioners, Elko County, Nevada

Tooele County Commissioners, Tooele County, Utah

Applied Ecological Services, Inc., Salt Lake City, Utah

7.0 PERSONS AND AGENCIES CONSULTED

7.0 PERSONS AND AGENCIES CONSULTED

7.1 PERSONAL INTERVIEWS

Walter G. Sanders, Mayor, City of West Wendover, Nevada

Mike Nannini, Commissioner, Elko County, Nevada

Janice M. Fox, City Manager, City of West Wendover, Nevada

Lisa M. J. Lindblad, U. S. Air Force, Attorney-Advisor, Environmental Law Division, Office of the Staff Judge Advocate, Hill Field, Utah

L. Scott Rogers, P. E. Aqua Environmental Services, Inc. and Engineer, City of West Wendover, Nevada

C. J. Post, Registered Professional Surveyor, City of West Wendover, Nevada

George R. E. Boucher, County Manager, Elko County, Nevada

Dale Armstrong, Assistant County Manager, Elko County, Nevada

Deborah M. Smith, Executive Director, Northeast Nevada Development Authority (NENDA), Elko City, Nevada

David Vandenberg, District Planning and Environmental Coordinator Bureau of Land Management, Elko District, Nevada

Robert Marchio, Wells Resource Area Realty Specialist, Bureau of Land Management, Elko District, Nevada

Paul Blackburn, Elko County Soil Conservation Service, Elko, Nevada

Brenda Morgan, Mayor, Wendover, Utah

Winston Snyder, Public Works Director, West Wendover City, Nevada

Kay W. Winn, U. S. Air Force, Program Manager, National Environmental Policy Act (NEPA), Hill Field, Utah

Art Gravenstein, Environmental Specialist, Department of Defense (DOD), Bureau of Federal Facilities, Carson City, Nevada

Fred R. Snyder, Senior Hydrologist, Environmental Services, Radian Corporation, Salt Lake City, Utah

Shane D. Hirschi, P. E., U. S. Air Force, Restoration Project Manager, Environmental Management Directorate, Hill Field, Utah

7.2 AGENCIES CONSULTED

U. S. Air Force, National Environmental Policy Act (NEPA), Hill Field, Utah

U. S. Air Force, Environmental Management Directorate, Hill Field Utah

Department of Conservation and Natural Resources, Division of Environmental Protection, Carson City, Nevada

Bureau of Land Management, Elko District, Nevada

Bureau of Land Management, Tooele County, Utah

Soil Conservation Service, Elko County, Nevada

Radian Corporation, Salt Lake City, Utah

U. S. Air Force, Office of the Staff Judge Advocate, Hill Field, Utah

7.3 MEETINGS HELD WITH AGENCIES AND GOVERNMENTAL LEADERS

7.3.1 Meeting: Nevada Division of Environmental Protection, Carson City, Nevada, May 4, 1994.

Propose of the meeting was to examine the study entitled "Preliminary Assessment/Site Investigation for the Wendover Air Force Auxiliary Field and Utah Test and Training Range," prepared by the Radian Corporation. Participants included:

Art Gravenstein, Environmental Specialist, Carson City

Nevan Kane, Hydrogeologist, State of Nevada

Shane D. Hirschi, Project Manager, Hill Air Force Base, Utah

Robert T. Elliot Chief, Restoration Division, Hill Air Force Base, Utah

Fred R. Snyder, Senior Hydrologist, Radian Corporation

Paul R. Bitter, Senior Engineer, Radian Corporation

Wesley T. Maughan, Senior Scientist, Applied Ecological Services, Inc., Logan, Utah

7.3.2 Meeting: Elko County, Nevada Commission Meeting, July 20, 1994

The purposed of the meeting was to inform the Board of Commissioners and other interested citizens of the pending land transaction in the City of West Wendover and gain from them their interest or concerns relating to the proposed land exchange. Participants included:

Llee Chapman, Chairman, Elko County Commissioner

Barbara Wellington, Elko County Commissioner

Mike Nannini, Elko County Commissioner

Dale Porter, Elko County Commissioner

Roberta Shelton, Elko County Commissioner

George Boucher, Elko County Manager

Dale Armstrong, Elko County Assistant Manager

Janice M. Fox, City Manager, West Wendover City

Wesley T. Maughan, Senior Scientist, Applied Ecological Services, Inc.

Elected officials and other citizens from communities throughout Elko County, Nevada

7.3.3 Meeting: West Wendover City Council, West Wendover City, Nevada, January 17, 1995.

Purpose of the meeting was to examine progress made by Applied Ecological Services, Inc., and West Wendover City in developing an Environmental Baseline Survey and an Environmental Assessment for the proposed Air Industrial Park and learn from the council members concerns they may have relative to these studies and the proposed development.

Walter G. Sanders, Mayor

Howard Copelan, City Councilman

Yoland Duran, City Councilman

Andrea Level, City Councilman

Janice M. Fox, City Manager

Karen Shepherd, Assistant City Manager

Judy May, City Clerk/Recorder

W. T. Maughan, Senior Scientist, Applied Ecological Services, Inc.

Concerned citizens of The City of West Wendover, Nevada

7.3.4 Meeting: Wendover, Utah, City Council, January 17, 1995.

Purpose of the meeting was to examine progress made by Applied Ecological Services, Inc., and West Wendover City in developing an Environmental Baseline Survey and an Environmental Assessment for the proposed Air Industrial Park and learn from the council members concerns they may have relative to these studies and the proposed development. Participants included:

Brad Merl, City Councilman

George Gieber, City Councilman

James Trammell, City Councilman

Daniel Mathews, City Councilman

Margaret Wheeler, City Clerk

W. T. Maughan, Senior Scientist, Applied Ecological Services, Inc.

7.3.5 Meeting: Tooele County Commission, Tooele, Utah, January 24, 1995

Purpose of the meeting was to examine progress made by Applied Ecological Services, Inc., and West Wendover City in developing an Environmental Baseline Survey and Environmental Assessment for the proposed Air Industrial Park and learn from the commission members concerns they may have relative to these studies and the proposed development. Participants included:

Teryl Hunsaker, Chairman, Tooele County Commission

Lois McCarther, Commissioner*

Gary Griffith, Commissioner*

W. T. Maughan, Senior Scientist, Applied Ecological Services, Inc.

*Commissioners McCarther and Griffith were unable to attend this meeting. The commissioners received a copy of the agenda, Appendix F and were appraised of its contents by Mr. Hunsaker.

8.0 REFERENCES

8.0 REFERENCES

8.1 SOIL, TOPOGRAPHY AND VEGETATION

Cowardin, L., V. Carter, F. Golet, and E. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Department of Interior, U.S. Fish and Wildlife Service. Rep. No. FWS/OBS-79/31. Washington, D.C. 103 pp.

Environmental Laboratory. 1987. Corps of Engineers Wetlands Delineation Manual, Technical Report Y-87-1, US Army Engineer Waterways Experiment Station, Vicksburg, Miss.

Radian Corporation 1993. Preliminary Assessment/Site Investigation, Wendover Air Force Auxiliary Field Utah Test and Training Range, Draft Volume I. Unpublished report submitted to Hill Air Force Base, Utah.

Reed, P.B. 1988. National List of Plant Species That Occur in Wetlands: Region 8 Fish and Wildlife Service, U.S. Department of the Interior, Biological Report, May 1988.

Soil Conservation Service. 1985. Hydric Soils of Utah. In cooperation with the National Technical Committee for Hydric Soils, United States Department of Agriculture, Soils Conservation Service, Salt Lake City, Utah.

Trickler, Darryl L. 1986. Air Force Base, Utah Soil and Range Survey. Soil Conservation Service, U.S. Department of Agriculture, Salt Lake City, Utah Office, May 1986.

USDA 1988. National Food Security Act Manual. U.S. Department of Agriculture, U.S. Government Printing Office, Washington, D.C.

Draft Environmental Baseline Survey, Air Industrial Park and Compost Facility, Wendover Air Force Auxiliary Field, Elko County Devada and West Wendover City, Nevada, Applied Ecological Services, Inc., Salt Lake City, Utah. November 1994.

8.2 HYDROLOGY

Radian Corporation 1993. Preliminary Assessment/Site Investigation, Wendover Air Force Auxiliary Field Utah Test and Training Range, Draft Volume I. Unpublished report submitted to Hill Air Force Base, Utah.

HWS Consulting Group. 1993. Environmental Baseline Study. 1,357.64 acres within the Wendover Air Force Auxiliary Field, Elko County, Nevada.

8.3 GEOLOGY

Bedinger, M.S., K.A. Sargent, and W.H. Langer. 1990. Studies of Geology and Hydrology in the Basin and Range Province, Southwestern United States, for Isolation of High-Level Radioactive Waste--Characterization of the Bonneville Region, Utah and Nevada. U.S. Geological Survey Professional Paper 1370-G.

Radian Corporation 1993. Preliminary Assessment/Site Investigation, Wendover Air Force Auxiliary Field Utah Test and Training Range, Draft Volume I. Unpublished report submitted to Hill Air Force Base, Utah.

Smith, R.M. 1976. Mineral Resources of Elko County, Nevada. U.S. Geological Survey Open-File Report 76-56.

8.4 WILDLIFE

Behle, W. H., and M. L. Perry. 1975. Utah birds: check-list, seasonal ecological occurrence charts and guides to bird findings. Museum of Nat. His., Univ. of Utah, Salt Lake City, Utah. 144 pages.

Bernard, S. R., and K. F. Brown. 1977. Distribution of mammals reptiles and amphibians by BLM physiographic regions, and A. W. Kuchler's associations for the eleven western states. BLM Tech, Note 301.

Durrant, S. D. 1952. Mammals of Utah: Taxonomy and distribution. Univ. Kansas Press. Laurence, Kansas. 549 pages.

Hall, E. R., and K. R. Kelson. 1959. The mammals of North America. Vol. I and II. Ronald Press. New York. 1083 pages + 158 page index.

Hayward, C. L., C. Cottam, A. M. Woodbury, H. H. Frost, R. Porter, and R. J. Erwin. 1976. Birds of Utah. In: Great Basin Naturalist Memoirs. Brigham Young University, Provo, Utah. 229 pages.

Stebbins, R. C. 1966. A field guide to western reptiles and amphibians. Houghton Mifflin Co., Boston, Mass. 270 pages.

Tanner, W. W. 1975. Checklist of Utah amphibians and reptiles. Proceedings of the Utah Acad. of Sci., Arts and Letters. Vol. 52(1):4-8.

Workman, G. W., W. T. Maughan, L. S. Neilson, T. R. Hougaard, and E. M. Rawlings. 1992. Natural resource management plan for the Hill Air Force Base Range, Wendover Air Force Range and Little Mountain Test Facility, Utah. U. S. Air Force Publication. 221 pages.

Draft Environmental Baseline Survey, Air Industrial Park and Compost Facility, Wendover Air Force Auxiliary Field, Elko County Devada and West Wendover City, Nevada, Applied Ecological Services, Inc., Salt Lake City, Utah. November 1994.

8.5 METEOROLOGY

Climate data on files at the Utah Climate Center, Utah State University, Logan, Utah 84322-4825.

8.6 SOCIOECONOMIC

Draft Environmental Baseline Survey, Wendover Air Force Auxiliary Field, Elko County, Nevada, HWS Consulting Group, Inc. Denver Colorado, May 24, 1993.

Radian Corporation 1993. Preliminary Assessment/Site Investigation, Wendover Air Force Auxiliary Field Utah Test and Training Range, Draft Volume I. Unpublished report submitted to Hill Air Force Base, Utah.

Wendover Airport, Master Plan Study 1990-2010 and Historic American Building Survey, Muller, Sirhall and Associates, Inc., Aurora Colorado, 1991.

Sewage Sludge and Municipal Solid Waste Composting Facility. Preliminary Design Report, City of West Wendover, Nevada prepared by L. Scott Rogers, P. E., Aqua Environmental, and Stuart A. Powel P. E., City Engineer/Manager, June 1993.

West Wendover City, Master Land Use Plan, August 5, 1993, Map Figure 3.

Draft Environmental Baseline Survey, Air Industrial Park and Compost Facility, Wendover Air Force Auxiliary Field, Elko County, Nevada and West Wendover City, Nevada, Applied Ecological Services, Inc., Salt Lake City, Utah. November 1994.

8.7 ARCHAEOLOGY

Aikens, C. Melvin. 1970. Hogup Cave. University of Utah Anthropological Papers No. 93. Salt Lake City.

Aikens, C. Melvin, and David B. Madsen. 1986. Prehistory of the Eastern Area. In: Handbook of North American Indians, Vol. 11, Great Basin, Warren L. d'Azevedo, ed., pp. 149-160. Washington: Smithsonian Institution.

Arkush, Brooke S. 1986. Aboriginal Exploitation of Pronghorn in the Great Basin. Journal of Ethnobiology 6(2):239-255.

Arkush, Brooke S., William B. Fawcett, and Gar W. Workman. 1992. A 1991 Archaeological Assessment of U. S. Air Force Designated Lands in Utah. MS on file, Antiquities Section, Utah Division of State History, Salt Lake City.

Arkush, Brooke S., and Gar W. Workman. 1992. An Archaeological Assessment of the U. S. Air Force Utah Test and Training Range: The 1992 Field Season. MS on file, Antiquities Section, Utah Division of State History, Salt Lake City.

Benson, L. V., D. R. Currey, R. I. Dorn, K. R. Lajoie, C. G. Oviatt, S. W. Robinson, G. I. Smith, and S. Stine. 1990. Chronology of Expansion and Contraction of Four Great Basin Lake Systems During the Past 35,000 Years. Palaeogeography, Palaeoclimatology, and Palaeoecology 78:241-286.

Billat, L. B., S. C. Billat, D. E. Newman, M. A. Overstreet, R. K. Talbot, and J. D. Wilde. 1986. Class III Cultural Resource Inventory Along the U.S Telecom Fiber Optic Cable Corridor Across Northern Utah, Northern Nevada, and Northeastern California. MS on file, Bureau of Land Management Elko District Office, Elko, Nevada.

Carr, Stephen L., and Robert W. Edwards. 1989. Utah Ghost Rails. Salt Lake City: Western Epics.

Chamberlin, Ralph V. 1911. Ethno-botany of the Gosiute Indians of Utah. Memoirs of the American Anthropological Association 2(5):329-405. Lancaster, Pa.

Hall, H. J. 1988. Human Fecal Analysis of Danger and Floating Island Caves. Paper presented at the 21st Biennial Meeting of the Great Basin Anthropological Conference, Park City, Utah.

Holmer, Richard N. 1988. Lithic Analysis of the Silver Island Expedition. Paper presented at the 21st Biennial Meeting of the Great Basin Anthropological Conference, Park City, Utah.

Horne, Melinda C. 1983. Cultural Resources Report for the Wendover Sewer Line Project. MS on file, Bureau of Land Management Elko District Office, Elko, Nevada (#BLM 1-592).

Janetski, Joel C. 1982. Cultural Resources Report for the Wendover Water Reservoir Project. MS on file, Bureau of Land Management Elko District Office, Elko, Nevada (#BLM 1-551[P]).

Jerrems, William. 1977. Archaeological Reconnaissance for a New Jail Site, West Wendover, Nevada. MS on file, Bureau of Land Management Elko District Office, Elko, Nevada (#BLM 1-103).

Johnson, Roger. 1990. Scobie Road Project Cultural Resource Report. MS on file, Bureau of Land Management Elko District Office, Elko, Nevada (#BLM 1-1150[P]).

Jennings, Jesse D. 1953. Danger Cave: A Progress Summary. El Palacio 60(5):179-213.

_______. 1957. Danger Cave. University of Utah Anthropological Papers No. 27. Salt Lake City.

_______. 1978. Prehistory of Utah and the Eastern Great Basin. University of Utah Anthropological Papers No. 98. Salt Lake City.

Launius, Roger D. 1991. Home on the Range: The U. S. Air Force Range in Utah, A Unique Military Resource. Utah Historical Quarterly 59(4):332-360.

Livingston, Stephanie D. 1988. Faunal Remains from Recent Excavations at Danger Cave. Paper presented at the 21st Biennial Meetings of the Great Basin Anthropological Conference, Park City, Utah.

Madsen David B. 1988. Danger Cave: The Fourth Iteration. Paper presented at the 21st Biennial Meetings of the Great Basin Anthropological Conference, Park City, Utah.

Madsen, David B., and David Rhode. 1990. Early Holocene Pinyon (Pinus monophylla) in the Northeastern Great Basin. Quaternary Research 33:94-101.

Marchio, Robert. 1991. West Wendover Waste Water Treatment Plant Distribution Line Cultural Resource Report. MS on file, Bureau of Land Management Elko District Office, Elko, Nevada (#BLM 1-1211[N]).

Marwitt, John P. 1986. Fremont Cultures. In: Handbook of North American Indians, Vol. 11, Great Basin, Warren L. d'Azevedo, ed., pp. 161-172. Washington: Smithsonian Institution.

Miller, David G. 1985. Cultural Resources Report for the Right-of-Way Betterment and Slope Cutting Along U.S. 93A. MS on file, Bureau of Land Management Elko District Office, Elko, Nevada (#BLM 1-835[P]).

Murphy, Timothy W. 1984. Wendover Sewage Lagoon, Wendover School Site, and Wendover Water Tank Cultural Resources Report. MS on file, Bureau of Land Management Elko District Office, Elko, Nevada (#BLM 1-674[P]).

Myrick, David F. 1962. Railroads of Nevada and Eastern California, Vol. II. Berkeley: Howell-North Books. (Vol. I).

Polk, Michael R. 1990. A Cultural Resources Survey of a Proposed Culinary Water Line Near Wendover, Nevada. MS on file, Antiquities Section, Utah Division of State History, Salt Lake City.

Rhode, David. 1988. Archaeobotanical Remains from Danger Cave. Paper presented at the 21st Biennial Meetings of the Great Basin Anthropological Conference, Park City, Utah.

Rudy, Jack R. 1953. Archaeological Survey of Western Utah. University of Utah Anthropological Papers No. 12. Salt Lake City.

Russell, Kenneth W. 1986. A Cultural Resource Inventory of Firing Range Prospect #23107, Tooele County, Utah. MS on file, Antiquities Section, Utah Division of State History, Salt lake City.

Smith, Elmer R. 1942. Early Man in the Great Salt Lake Area. Mineralogical Society of Utah 3(2):27-32.

Steward, Julian H. 1938. Basin-Plateau Aboriginal Sociopolitical Groups. Bureau of American Ethnology Bulletin 120. Washington. (Reprinted: University of Utah Press, Salt Lake City, 1970.)

________. 1941. Culture Element Distributions XIII: Nevada Shoshone. University of California Anthropological Records 4(2):209-360. Berkeley.

Stokes, William L. 1986. Geology of Utah. Salt Lake City: Utah Museum of Natural History and Utah Geological and Mineral Survey.

Actions accomplished by leaders of Elko County, Nevada and West Wendover City between 1982 and 1993.

1. In 1982 the parcel of land was first surveyed indicating the area included 1,357.64 acres of land.

2. March 1982 the Elko County Commissioners received a Certificate of Clearance, Unrestricted for Sub-Surface Use/Sewage Treatment Plant, from the U. S. Air Force for the east one-half of Section 21, Appendix B. This Certificate was received after the land had been scarified to a depth of two feet to determine possible contamination from debris or ordnance.

3. During 1985 Elko County, Nevada completed the West Wendover City sewage treatment plant and lagoon system. A bi-product of the sewage system, gray water, is now used to irrigate the Toana Vista Golf Course and other city recreational property.

4. December 12, 1989 the Bureau of Land Management awarded Elko County and the Town of Wendover, a RIGHT-OF-WAY GRANT/TEMPORARY USE PERMIT, in perpetuity, for the northern 200 acres of the eastern one-half of Section 21, Appendix C.

5. July 10, 1990 Elko County received a Certificate of Clearance from the U. S. Air Force for Scobie Road and Airport Way, Appendix D. This Certificate was received after a 100 foot right-of-way had been cleared with a ferrous ordnance detector to a depth of 10 feet as required by the BLM.

6. May 10, 1991 the Town of Wendover, Elko County Nevada was incorporated under the name of the City of West Wendover, Nevada.

7. August, 1992 the City of West Wendover received a Certificate of Clearance from the U. S. Air Force for surface clearance of the 1,357.64 acres under investigation, Appendix E.

8. August 5, 1993 The City of West Wendover completed the City Master Land Use Plan which incorporated the proposed Air Industrial Park within future city limits, page 11.

APPENDIX B

CERTIFICATE OF (SUB-SURFACE) CLEARANCE, 391.98 ACRES

CERTIFICATE OF CLEARANCE

Unrestricted for Sub-Surface use/Sewage Treatment Plant

1. The half section land within the Utah Test and Training Range (approximately 319.98 acres), located between Wendover Air Force Auxiliary Field and Highway U.S. 93 alternate, which lie just inside the State of Nevada and as described below, have been given a careful search and have been cleared of all dangerous and/or explosive ordnance materials and residue reasonably possible to detect to a depth of 24 inches, and permits use of the land for any purpose not requiring sub-surface development beneath this depth.

2. A section of land beginning at a point S 89^0 57' E, 2,634.72 feet from the northwest corner of section 21, T 33N, R 70E, MT. Diablo B.M.; thence S 89^0 57' E, 2640.0 feet along the north section line of said section 21, to the northeast corner of section 21; thence S 0^0 02' W, 5280 feet to the southeast corner of said section 21, thence N 89^0 56' W, 2640.0 feet along the south line of said section 21; thence N 0^0 02' E, 5279.23 feet to the point of begining. Said parcel equals to 319.98 acres.

3. A pipeline right of way, cleared to 20 feet in width, beginning N89^0 57' W, 4062.43 feet, from the Northwest corner of section 21, T33 N, R70E, Mt. Diablo B.M., thence N 4^0 56' 17" W, 2076.90 feet to the highway right of way.

4. The attached map reflects the area decontaminated.

5. Anytime excavation of this land below 24 inches cleared level occurs, explosive ordnance disposal personnel should be present to assist in rendering safe, or disposing of any ordnance found.

6. This clearance fulfills the requirement for transfering this portion of the Utah Test and Training Range from active to inactive status.

Robert E. Stinemates

ROBERT E. STINEMATES, TSgt, USAF
Operations and Plans Branch

APPENDIX C

RIGHT-OF-WAY GRANT/TEMPORARY USE PERMIT, 200 ACRES

Form 2800-14
(August 1985)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

RIGHT-OF-WAY GRANT/TEMPORARY USE PERMIT

Issuing Office
Elko District

Serial Number
N-52281

1. A (right-of-way) (permit) is hereby granted pursuant to:

a. [X] Title V of the Federal Land Policy and Management Act of October 21, 1976 (90 Stat. 2776; 43 U.S.C. 1761);

b. [ ] Section 28 of the Mineral Leasing Act of 1920, as amended (30 U.S.C. 185);

c. [ ] Other (describe) __________.

2. Nature of Interest:

a. By this instrument, the holder Elko County receives a right to construct, operate, maintain, and terminate a sewage treatment facility on public lands (or Federal land for MLA Rights-of-Way) described as follows:

T. 33 N., R. 70 E.,
Sec. 21, NE¼, N½N½SE¼.

Record Posted	Date	By
MT Plat	1/22/90	[illegible]
OG Plat	1/22/90	[illegible]
USE Plat		
HI Plat	1/22/90	[illegible]
CDI Filming		

b. The right-of-way or permit area granted herein is 2,640 feet wide, 3,300 feet long and contains 200 acres, more or less. If a site type facility, the facility contains ______ acres.

c. This instrument shall ~~XXXXXXXX~~ be in perpetuity , ______ ~~XXXX~~ from its effective date unless, prior thereto, it is relinquished, abandoned, terminated, or modified pursuant to the terms and conditions of this instrument or of any applicable Federal law or regulation.

d. This instrument [X] may [ ] may not be renewed. If renewed, the right-of-way or permit shall be subject to the regulations existing at the time of renewal and any other terms and conditions that the authorized officer deems necessary to protect the public interest.

e. Notwithstanding the expiration of this instrument or any renewal thereof, early relinquishment, abandonment, or termination, the provisions of this instrument, to the extent applicable, shall continue in effect and shall be binding on the holder, its successors, or assigns, until they have fully satisfied the obligations and/or liabilities accruing herein before or on account of the expiration, or prior termination, of the grant.

3. Rental:

For and in consideration of the rights granted, the holder agrees to pay the Bureau of Land Management fair market value rental as determined by the authorized officer unless specifically exempted from such payment by regulation. Provided, however, that the rental may be adjusted by the authorized officer, whenever necessary, to reflect changes in the fair market rental value as determined by the application of sound business management principles, and so far as practicable and feasible, in accordance with comparable commercial practices.

4. Terms and Conditions:

a. This grant or permit is issued subject to the holder's compliance with all applicable regulations contained in Title 43 Code of Federal Regulations parts 2800 and 2880.

b. Upon grant termination by the authorized officer, all improvements shall be removed from the public lands within 182 days, or otherwise disposed of as provided in paragraph (4)(d) or as directed by the authorized officer.

c. Each grant issued pursuant to the authority of paragraph (1)(a) for a term of 20 years or more shall, at a minimum, be reviewed by the authorized officer at the end of the 20th year and at regular intervals thereafter not to exceed 10 years. Provided, however, that a right-of-way or permit granted herein may be reviewed at any time deemed necessary by the authorized officer.

d. The stipulations, plans, maps, or designs set forth in Exhibit(s) A, dated --, attached hereto, are incorporated into and made a part of this grant instrument as fully and effectively as if they were set forth herein in their entirety.

e. Failure of the holder to comply with applicable law or any provision of this right-of-way grant or permit shall constitute grounds for suspension or termination thereof.

f. The holder shall perform all operations in a good and workmanlike manner so as to ensure protection of the environment and the health and safety of the public.

IN WITNESS WHEREOF, The undersigned agrees to the terms and conditions of this right-of-way grant or permit.

Ernie Hall	Rodney Harris
(Signature of Holder)	(Signature of Authorized Officer)
CHAIRMAN - ELKO COUNTY COMMISSION	District Manager
(Title)	(Title)
DECEMBER 6, 1989	December 12, 1989
(Date)	(Effective Date of Grant)

APPENDIX D

SCOBIE ROAD RIGHT-OF-WAY

ENVIRONMENTAL ASSESSMENT CERTIFICATE

1. TITLE OF PROPOSED ACTION
Scobie Road Right of Way

2. CONTROL NUMBER

3. CERTIFICATION
An environmental assessment has been accomplished under my direction, based on the attached description of the proposed action and alternatives (~~Atch 1, AF Form 813 dated~~ , sheets to .) The assessment of environmental effects is attached (Atch 2, sheets 1 to 6 .)

NAME AND GRADE OF ENVIRONMENTAL PLANNER	SIGNATURE	DATE
KAY WINN GS-09	Kay Winn	10 Aug 90

4. RECOMMENDATION
I have reviewed the attached DOPAA and environmental assessment and recommend:

- [x] Finding of no significant impact
  - [ ] 30 day waiting period required
  - [x] 30 day waiting period not required
- [ ] Proposed draft environmental impact statement required

NAME AND GRADE, CHIEF, ENGINEERING AND ENVIRONMENTAL PLANNING BRANCH	SIGNATURE	DATE
Robert J. VanOrman, GM-15 Ch, Environmental Mgmt Directorate	James R. VanOrman	10 Aug 90

5. REMARKS

The unincorporated city of West Wendover Nevada has established a requirement to provide a secondary access road to allow safe and efficient flow of traffic to the south part of the city. This roadway will require a right-of-way approximately 5000 feet in length and 100 feet in width. This right-of-way is within lands under military withdrawal (Public Land Order 627) via the Department of the Army. The caretaker presently is the Department of the Air Force.

This road construction is an extension of past and future intrastructure improvements being under taken by this unincorporated area. This includes a modernization of the sewer system initiated in 1981, upgrade of the water supply system initiated in 1984 and improvements to roadway systems initiated in 1986. Prior assessments for improvements in close proximity of this road have not indicated any environmental impacts other than control of fugitive dust. Specifications for this proposal outline necessary procedures for this control.

The roadway will not affect air or water quality, ambient noise levels, land use or generate additional use of resources. No hazardous materials are to be generated. Natural resource habitat is extremely limited due to the desert climate and there are no endangered species involved. The road improvement will eliminate a serious problem with access to the south portion of the city which is periodically disrupted by the railroad that bisects the town.

In view of these findings no Environmental Impact Statement is required.

6. ENVIRONMENTAL PROTECTION COMMITTEE APPROVAL *(INITIATING LEVEL)*

NAME AND GRADE OF CHAIRPERSON, EPC	SIGNATURE	DATE
JOHN C. GRIFFITH, Brig Gen, USAF Vice Commander Hill Air Force Base, Utah	John C. Griffith	14 aug 90

7. ORGANIZATION CONCURRENCE *(INITIATING LEVEL)*

NAME AND GRADE, ORGANIZATION COMMANDER	SIGNATURE	DATE
Dom A. DeSantis, Jr. Col, USAF Base Civil Engineer	Dom A. DeSantis	12 AUG 90

8. ENVIRONMENTAL PROTECTION COMMITTEE CONCURRENCE *(HIGHER LEVELS, AS REQUIRED)*

NAME AND GRADE OF CHAIRPERSON, EPC	SIGNATURE	DATE

DEPARTMENT OF THE AIR FORCE
2701ST EXPLOSIVE ORDNANCE DISPOSAL SQUADRON (AFLC)
HILL AIR FORCE BASE, UTAH 84056

Certificate of Clearance 10 July 90

1. The tract of land described in Atch 1 is located in portions of section 15 and section 16, T. 33N., R. 70E., outside of West Wendover, Elko County, NV., and located on the Wendover Bombing and Gunnery Range.

2. This tract of land as described and outlined in Atch 1 as obtained from Chilton Engineering and Surveying Ltd, State of Nevada.

3. Land described was surface cleared of all dangerous and or explosive ordnance materials and residue reasonably possible to detect out 50 feet on either side of the center line of the proposed road way. Additionally, the land tract described has been subsurface cleared to a depth of 16 feet by the use of ferrous ordnance detectors.

4. Should any further subsurface excavation be conducted inside this defined area and beyond depths stated, explosive ordnance disposal personnel should be present to assist in disposing of any ordnance or residue found.

5. Should any surface or subsurface or excavation be planned outside this defined area, further inspection, clearance, and certification will be required.

6. This tract of land is clear to the best of our knowledge and capabilities. The possibility still exists that ordnance or residue could be uncovered in the defined areas. Clearance perimeters are stated in Atch 1.

7. The clearance fulfills the requirements for the proposed road bed, as requested by Juanitta W. Barnes, Real Estate Specialist, 2849 ABG, Hill AFB, Utah.

DL Murray

DOUGLAS L. MURRAY, Major, USAF
Commander

APPENDIX E

CERTIFICATE OF (SURFACE) CLEARANCE, 1,357.64 ACRES

CERTIFICATE OF CLEARANCE

1. Portions of sections 15, 16, 20, 21, and 22, Township 33 North, Range 70 East M.D.B. and M. West Wendover, Nevada and described in attached Legal Land Description (atch 1) and Record of Survey (atch 2) totalling approximately 1387 acres have been given a careful and thorough surface search for dangerous and/or explosive ordnance materials.

2. The attached map reflects the area decontaminated. (see page 22)

3. This was a surface clearance only. Its purpose was to allow surveyors and planners safe access to this area to aid in planning future construction. Any contruction/excavation could result in hazardous explosive ordnance being uncovered. Before any construction/excavation is undertaken, explosive ordnance disposal personnel should be called in to perform a subsurface clearance within the boundaries of the construction site.

4. Date of clearance was 21 to 28 August 1992.

David A. Bowler

DAVID A. BOWLER, MSgt, USAF
NCOIC, Clearance Project

3 Atch
1. Legal land description
2. Record of survey
3. Map of area cleared

APPENDIX F

AGENDA, TOOELE COUNTY, COUNTY COMMISSIONERS MEETING

ENVIRONMENTAL ASSESSMENT MEETING
TOOELE COUNTY COMMISSIONERS
JANUARY 24, 1995
AGENDA

PURPOSE: To examine progress made by Applied Ecological Services, Inc., and West Wendover City in developing an Environmental Baseline Survey and an Environmental Assessment for the proposed Air Industrial Park and learn from commission members concerns they may have relative to these studies and the proposed development.

MEETING HELD WITH GOVERNMENTAL LEADERS AND AGENCIES

Nevada Division of Environmental Protection, Carson City, Nevada, May 4, 1994.

Elko County BLM and County Planners, May 2, 1994.

U. S. Air Force and local governmental leaders, West Wendover City, May 26, 1994.

U. S. Air Force, June 30, 1994.

Elko County Commission, July 20, 1994.

West Wendover City Council, January 17, 1995.

Wendover, Utah City Council, January 17, 1995.

Tooele County Commissioners, January 24, 1995.

ENVIRONMENTAL BASELINE SURVEY AND ENVIRONMENTAL ASSESSMENT

The Air Force has not signed off on the Baseline Survey, they will examine both studies, Environmental Assessment and the Environmental Baseline Survey at the same time.

The Nevada Division of Environmental Protection, Carson City, see a need for possible additional contamination study.

PROGRESS ON THE ENVIRONMENTAL ASSESSMENT

* Plants: No threatened or endangered species were found.

* Animals: No threatened or endangered species were found.

* Archaeology: Seven sites were found, four of which must be studied further before construction can take place.

* Soil: No hazardous or toxic compounds have been reported except arsenic and beryllium which may occur naturally in high concentration in soil in Eastern Nevada.

* Geology: Environmental consequences should be minimal.

* Meteorology: Environmental consequences should be minimal.

* Socioeconomics: The industrial park would supply a tax base for developing additional infrastruction (roads, water, sewer system etc.) for the city. The industrial park will also provide an additional job base for approximately 2,845 employees.

* Hydrology, Soil and Vegetation: Plants found and soil conditions observed suggest that the low-lying portions of the study area may be considered wetlands under the jurisdiction of the U. S. Army Corps of Engineers. An evaluation will need to be made by either the Corps in Reno or a private consultant, approved by the Corps, to determine if the area is classified as wetlands.

  Four groundwater monitoring wells were developed, in the study area, by the Radian Corporation in 1993. Well data taken in June, 1993 indicated that the water table was deeper than 25 feet in these areas. Janice Fox, West Wendover City Manager, is working with Air Force personnel to try to have the wells monitored quarterly. The Corps will need these data in order to make their final judgement on wetlands.

Reference 24

Ref 24

RECORD OF COMMUNICATION	DISCUSSION FIELD TRIP CONFERENCE PHONE CALL OTHER (SPECIFY) (Record of item checked above)	
TO: Janice Fox, City Manager West Wendover, Nevada. (702)664-3081	FROM: Barbara H. Benoy NDEP - Superfund (702) 687-4670 x-3026	DATE: 5/12/95 TIME: 1400

SUBJECT: Utah Test & Training Range Site
Subdivision location adjacent to landfill area

SUMMARY OF COMMUNICATION:

The subdivision appears closer on the map generated by the UNR SBDC, Demographic Report. According to Ms. Fox, the subdivision is at least 1.5 miles from the landfill boundary. There are no areas closer than 1.5 miles from the site with respect to closest resident.

CONCLUSIONS, ACTION TAKEN OR REQUIRED:

ROUTE TO: FILE: UTTR Site

Reference 25

Ref 25

BOB MILLER
Governor

STATE OF NEVADA

ROLAND D. WESTERGARD, P.E.
Director

PETER G. MORROS, P.E.
State Engineer

DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES

DIVISION OF WATER RESOURCES
Capitol Complex
201 S. Fall Street
Carson City, Nevada 89710
(702) 885-4380

44405 and 44406

Subdivision Review No. 3719F
February 1, 1989

TO: Toana Corporation
P.O. Box 2440
Wendover, Nevada 89883

NAME: West Wendover Highlands Unit No. 8

COUNTY: Elko - West Wendover, Great Salt Lake Desert Basin

LOCATION: Portion of the SW1/4 NE1/4 Section 17, T.33N., R.70E., M.D.B.&M.

PLAT: Final - 21 lots. (7.665 MGA or 23.52 AFA)

OWNER-DEVELOPER: Toana Corporation
P.O. Box 2440
Wendover, Nevada 89883

ENGINEER: Summit Engineering Corp.
572 Fifth Street
Elko, Nevada 89801

WATER SUPPLY: Unincorporated Town of West Wendover

GENERAL: Correspondence dated December 16, 1988, from the Elko County Engineering Services signed by Michael E. Murphy to the Division of Water Resources, states that the Unincorporated Town of West Wendover will serve water to the subject subdivision. This letter is a matter of public record on file in the Division of Water Resources office.

The water service commitment amount is based upon 1,000 gallons per day, or 1.12 AFA, per lot.

The proposed project area is within the place of use of water right permits in the name of Unincorporated Town of West Wendover.

The following water right permits in the Wendover Land Company are also appurtenant to the proposed project area:

Permits 44405 and 44406 issued for 4.0 c.f.s. and 943.6 million gallons annually (MGA) each for quasi-municipal and domestic purposes. The total combined duty under Permit 44405 and 44406 is 1,092.0 MGA.

A copy of this certificate shall be furnished to the subdivider who in turn shall provide a copy of such certificate to each purchaser of land prior to the time the sale is completed. Any statement of approval is not a warranty or representation in favor of any person as to the safety or quantity of such water (NRS 278.377).

ACTION: Approved to water quantity as required by statutes for the West Wendover Highlands Unit No. 8 subdivision based on water service by the Unincorporated Town of West Wendover.

Respectfully submitted,

Hugh Ricci

Hugh Ricci, P.E.
Chief, Ground Water Section

HR/jjs

cc: Division of Real Estate
Public Service Commission of Nevada
Bureau of Consumer Health Protection Services
Division of Environmental Protection
Elko County Commission
Summit Engineering Corp.
Unincorporated Town of West Wendover
Elko Branch Office

Reference 26

Ref 26

CHILTON Engineering and Surveying Ltd.

95 MAY -4 AM 11:32

RECEIVED
ENVIRONMENTAL
PROTECTION

May 2, 1995

Barbara Benoy
"Superfund" Branch
Division of Environmental Protection
333 West Nye Lane
Carson City, Nevada 89710

RE: D.W.R. Permit #44405 (Wendover Land Company)

Dear Barbara,

A short history of this permit, according to my files, is as follows:

The application was filed in 1981, with the water developed to be used for quasi-municipal purposes. It is located within the NW¼NW¼ Section 17, T.33N.,R.70E., M.D.M., near the City of West Wendover. Subsequently, the owner determined the water was not chemically fit for the intended purposes, and an agreement was executed (approximately 1987) with the then unincorporated town of West Wendover to lease the well as a site for the injection of fresh water of the permitted municipal supply, which comes through the transmission line from Big Spring and the wells near Silver Zone Pass. It was intended that water would be injected into the aquifer in the winter season of low municipal demand, and be pumped back into the irrigation system at the town's golf course when needed. The well still serves this golf course irrigation purpose, as allowed by DWR permit R-002, and NDEP permit NEV87023. The injected water is not used for municipal supply. The permit #44405 has been determined by DWR to be unnecessary, since beneficial use could not be proved from underground water developed <u>at that source</u>. The administrative authority has chosen to keep the permit alive, however, through filing of applications for extension of time, apparently to fulfill terms of the original agreement.

I hope I have provided you with the needed information.

Sincerely,

William A. Nisbet

William A. Nisbet

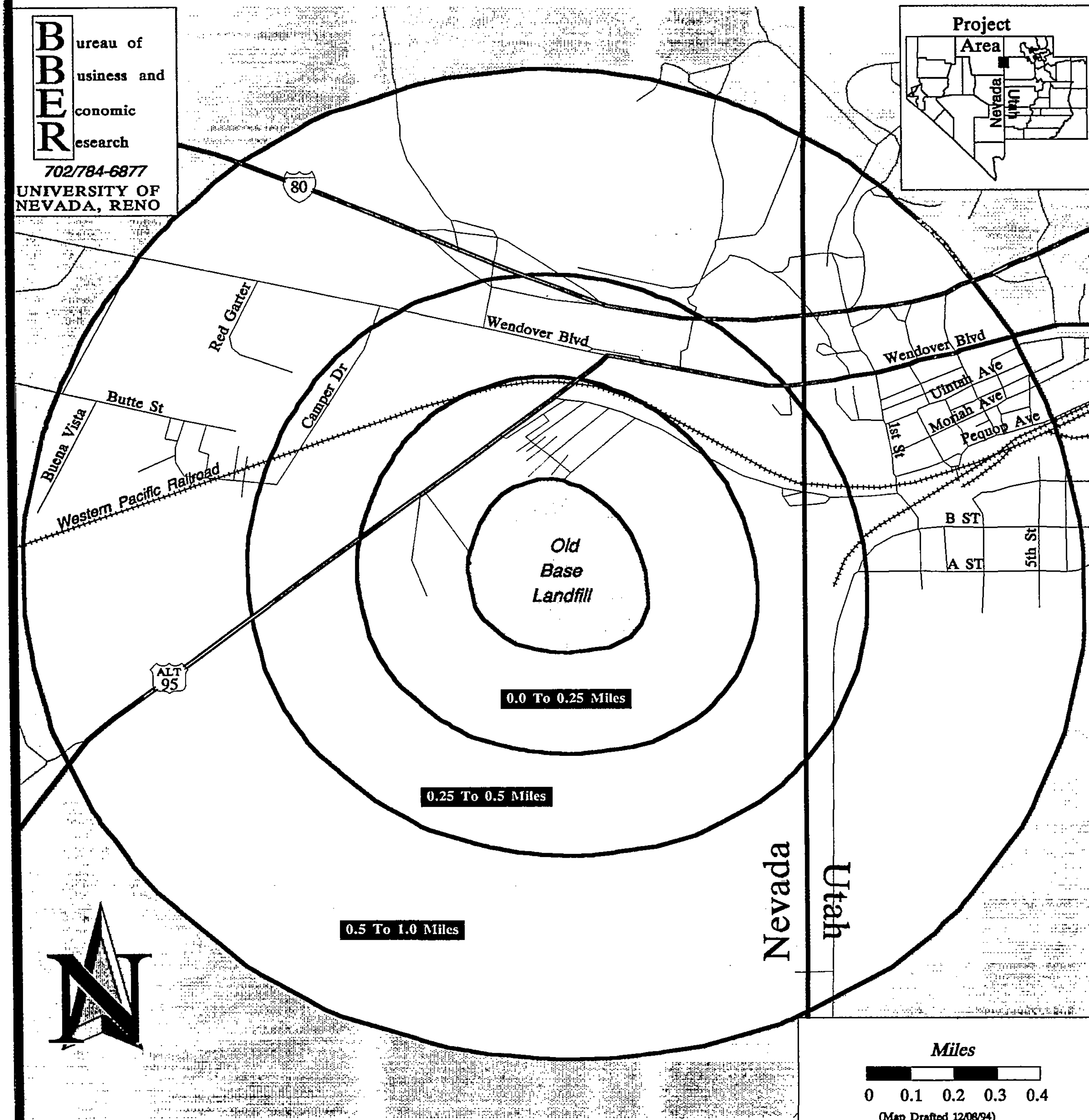
cc: Wendover Pipeline Company - Box 2988
City of West Wendover - Box 2825
West Wendover, Nevada 89883

Reference 27

Ref 27

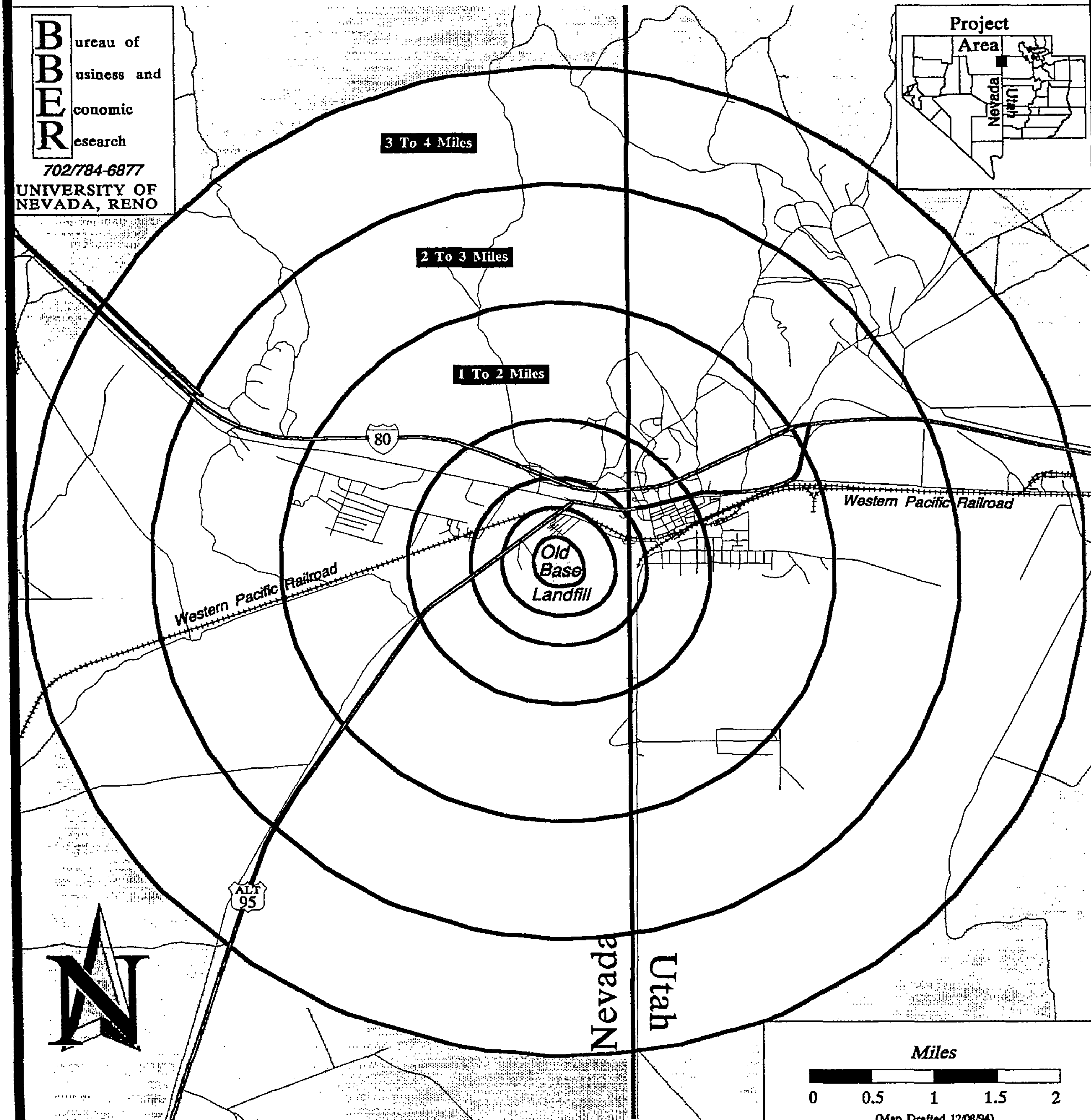
GEODEMOGRAPHIC ANALYSIS - WENDOVER AF AUXILIARY FIELD

WENDOVER, ELKO COUNTY, NEVADA & TOOELE COUNTY, UTAH



GEODEMOGRAPHIC ANALYSIS - WENDOVER AF AUXILIARY FIELD

WENDOVER, ELKO COUNTY, NEVADA & TOOELE COUNTY, UTAH



GEODEMOGRAPHIC ANALYSIS - WENDOVER AF AUXILIARY FIELD
1990 US CENSUS BLOCK LEVEL DATA
WENDOVER, ELKO COUNTY, NEVADA & TOOELE COUNTY, UTAH

RADIUS ZONE	AREA (SQ MILES)	TOTAL PERSONS	TOTAL HOUSING UNITS	TOTAL OCCUPIED HOUSING UNITS (HOUSEHOLDS)	TOTAL VACANT HOUSING UNITS	PERSONS PER HOUSEHOLD
0.0 To 0.25 Miles	0.6	13	6	4	2	3.2
0.25 To 0.5 Miles	0.9	87	45	34	11	2.5
0.5 To 1.0 Miles	3.0	1,130	409	327	82	3.3
1 To 2 Miles	10.7	629	224	195	29	3.2
2 To 3 Miles	16.9	284	115	104	11	2.7
3 To 4 Miles	23.2	356	144	130	14	2.7
Total (0 To 4 Miles)	55.4	2,499	943	794	149	3.0

NEAREST POPULATION CENTER: WEST WENDOVER, NEVADA
1994 POPULATION ESTIMATE (JULY 1): 2,582 (NV STATE DEMOGRAPHER)
1990 POPULATION (APRIL 1): 2,007 (US CENSUS)

(1990 POPULATION OF WENDOVER, UTAH: 1,127 (US CENSUS))

MINIMUM DISTANCE TO NEAREST POPULATION: 0.0 MILES

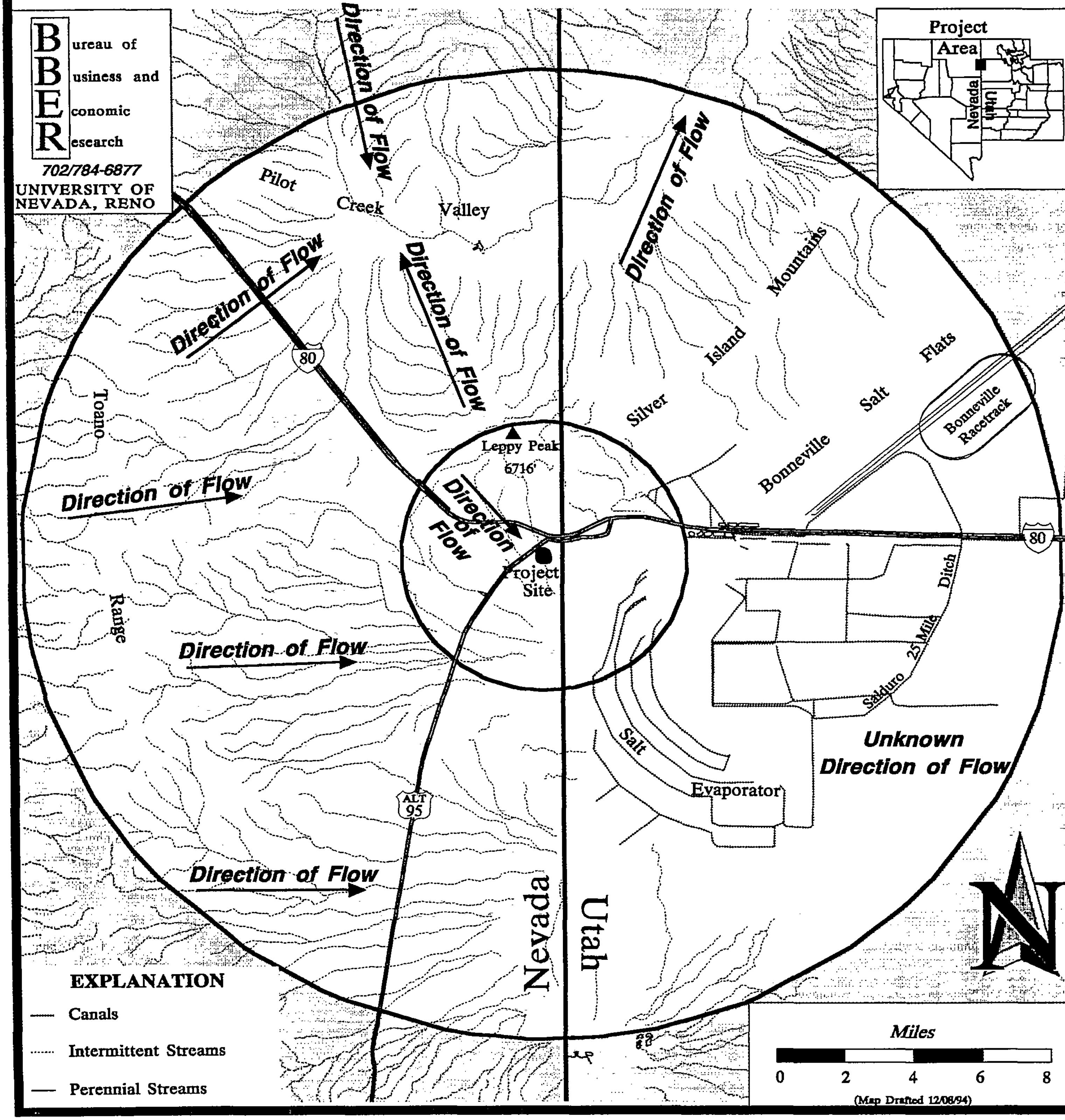
NOTE: DATA PROVIDED ARE POPULATION ESTIMATES ONLY AND ARE BASED ON SQUARE MILE AT THE BLOCK LEVEL.

ANY DISCREPANCIES BETWEEN TOTAL PERSONS/TOTAL OCCUPIED HOUSING UNITS AND PERSONS PER HOUSEHOLD ARE A RESULT OF PERSONS LIVING IN GROUP QUARTERS (PRISONS, DORMITORIES, MILITARY BARRACKS, ETC.).

DATA PROVIDED BY
BUREAU OF BUSINESS AND ECONOMIC RESEARCH
UNIVERSITY OF NEVADA, RENO
DECEMBER 8, 1994

SURFACE WATER FEATURE ANALYSIS - WENDOVER AF AUXILIARY FIELD

WENDOVER, ELKO COUNTY, NEVADA & TOOELE COUNTY, UTAH



SURFACE-WATER FEATURE REPORT - WENDOVER AF AUXILIARY FIELD
TOTAL LENGTHS OF FEATURE SEGMENTS WITHIN 15 MILES OF SELECTED SITE
WENDOVER, ELKO COUNTY, NEVADA & TOOELE COUNTY, UTAH

WATER FEATURE TYPE	FEATURE LENGTH IN MILES
CANALS	140.07
SHORELINES	8.19
INTERMITTENT STREAMS	725.74
PERENNIAL STREAMS	0.0
TOTAL LENGTH OF SURFACE WATER FEATURES	874.01

DATA PROVIDED BY
BUREAU OF BUSINESS AND ECONOMIC RESEARCH
UNIVERSITY OF NEVADA, RENO
DECEMBER 8, 1994